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ABSTRACT

This series of four environmental education units is designed for use at the high school level. The first unit, an advanced science and independent study, includes such topics as student requirements, advisor responsibilities, evaluation forms, research report format, a guide to Syracuse University libraries, and research ideas. The second unit, an ecology course, explores biotic interrelationships, air quality, water quality, and other ecology-related problems. Course requirements, a course time table, terminal objectives for each area of study, activities, diagrams, worksheets, tables, and reference materials are included. An environmental biology unit, the third unit, is a three-week unit which explores such topics as populations, communities, ecosystems, biomes, and biosphere. Worksheets, objectives, resources, project suggestions which correlate course text and other curriculum materials are included in the unit. The final unit deals with environmental physics, exploring noise, air pollution, the automobile, the bicycle, aircraft, solid waste, and electric power. Each topic includes activities and/or an information outline and discussion questions or topics. (TK)

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4621

EAST SYRACUSE-MINOA SCHOOLS

Environmental Education Materials

High School

① Advanced Science + Independent Study
② An Ecology Course
③ Environmental Biology
④ Environmental Physics

Produced Under USOE Grant OEG-0-71-4621
by East Syracuse-Minoa Central Schools
407 Fremont Road
East Syracuse, N.Y. 13057
Dr. Fritz Hess, Superintendent

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ADVANCED SCIENCE

and

INDEPENDENT RESEARCH

EAST SYRACUSE-MINOA HIGH SCHOOL

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ADVANCED SCIENCE REQUIREMENTS

1. Students will spend five periods (minimum) per week on independent study under supervision of an advisor for one or two semesters.

2. Students will meet twice a week for the first month of school. During this time students will be informed of: possible project ideas, use of library and other references, experimental designs, biometrics and statistics, and scientific apparatus. Advisor will do this with students assinged to him.

3. For the rest of the semester, students will meet with the advisor at least once a week to discuss progress, problems, etc.

4. A log must be kept of all his activities including: amount of time spent, library research, raw data, field trips, consultations with others, etc. This log will be submitted to his advisor once every two weeks.

5. By the 3rd week of school the students must select the discipline in which they will do research e.g. biology, chemistry, physics, geology, astronomy, psychology, etc. and present a statement of the problem they wish to investigate.

6. At the end of the first four weeks each student will have submitted to his advisor a rough draft of his research problem, experimental design and background research. He should follow the project format included in the course packet.

7. Science Club will periodically schedule speakers or field trips in all scientific disciplines. Advanced science students must attend five programs and write a critique of each.

8. All science teachers involved in Advanced Science will meet 8th period on the last Monday of each marking period to collectively determine the report card grade for each perticipating student. He will be evaluated on: biweekly log, consultations, with advisor, sophistication of project, time and effort spent, self assessment-after first marking period, all requirements on this sheet.

9. Near the end of the second marking period each student will give a ten minute talk on his progress to date and evaluate himself. All advisors and research students will be present. Prospective students for next semester will be invited so that they may have a better idea of what to expect independent research to be like and so they can see what type projects other students have done.

10. At the end of the year the student will submit a formal report following the format of scientific journal articles and also make an oral presentation to the science faculty. His final evaluation will be largely determined by these.

11. A student may be dropped at any time from Advance Science if he does not meet any of the above requirements or does not take the responsibility for indepentent research.

12. It is recommended that prospective Advanced Science students meet with advisors prior to the semester they will be doing research. It is hoped that they will have time to consider the degree of involvement required by research, possible areas for their research and choose an advisor so that most of the semester can actually be spent on the research project.

RESPONSIBILITIES OF ADVISORS

The advisor will -

1. Meet with his students as often as necessary to acquaint them with methods of research, assist him in choosing a problem to investigate and designing his experiment, and to help him organize his log.
2. Aid the student in obtaining materials, equipment and utilizing available resources.
3. Insure that the research is at an appropriate level of sophistication, is carried out in a controlled fashion and will yield unbiased significant data.
4. Encourage the student to use his time wisely and to develop the necessary self-discipline required by independent research.
5. Constantly assess the student's progress and assist him in self-evaluation.
6. Meet the last Monday of each marking period (during 8th period) with the other advisors to collectively evaluate the students progress in research and determine the report card grade.
7. Attend as many Science Club presentations or trips as possible.

ADVANCED SCIENCE RESEARCH SIX WEEK EVALUATION

Student________________________________

Advisor________________________________

Mark Period____________________________

Grade__________________________________

1. Time spent on project (five periods each week).

2 & 3. Weekly meetings with advisor (twice each week for first month of school).

4. Log - Time

Library Research

Data

Notes

5. Statement of problem to be investigated (by third week).

6. Experimental design (by fourth week). Identify controls and variables, techniques, materials needed, special equipment and specific procedure.

7. Critique of science club program.

8. Student's self evaluation. (After first marking period)

9. Oral presentation.

10. Final Report (at completion of project)

FORMAT FOR REPORT OF RESEARCH

I. Purpose - State your objective in one clear sentence. What are you trying to show? What problem are you trying to solve?

II. Hypothesis - Based on your library research and other experiences what results do you predict?

III. Experimental Design - (1) List in order all steps in the procedure you will follow to solve the problem. (2) Identify your variables and show that your investigation is well controlled. Those factors that you control and treat uniformly to all groups are the independent variables. The condition that varies from group to group is the dependent variable. If there is only one dependent variable at a given time and all other factors are uniform then any differences observed are most likely due to that variable. (3) List all materials and note the ones the school must provide. (4) Describe or illustrate any special apparatus or techniques you may employ.

IV. Data - Record all resusts and observations in a data table. Date each entry. For your final report summarize the significant data into tables, charts, graphs, drawings, photographs or what ever presentation displays your data in the simplest form.

V. Interpretation - Explain your results. Formulate conclusions based on your data, references and consultations with others. State whether the data have confirmed your original hypothesis. Footnote all ideas to the reference from which they came. This is the creative part of research, let your mind explore all avenues.

VI. Sources of Error - Discuss all limitations or biases that might have affected your observations or interpretations of them. State methods of improving or extending your research.

VII. Bibliography - List all references used even those not alluded to directly by a footnote. Include books, periodicals and people.

NOTE TAKING AND BIBLIOGRAPHY

When researching a problem it is necessary to devise a method of taking notes accurately and in an orderly fashion. A research problem can be made much more difficult and time consuming if a student must take time out to rearrange notes or to go back to recheck sources. You must remember that every idea, experiment, work, or method, etc., that you utilized in your research must be given credit. Therefore in order to fascilitate note taking, footnoting, and writing of the bibliography we have compiled the following suggestions:

A. Bibliography Card

1. Make a bibliography card for each source used. This card will facilitate writing of footnotes and bibliography.
2. Use a separate index card for each source.
3. Make out the card while you are initially using the source. It takes time to go back and locate the source again.
4. Place the following information on the card:

Author. Title. City: Publisher, Date, Pages.
Author. Article. Magazine, Date, Volume, Pages.

B. Bibliographical Form: All sources alluded to must be listed in alphabetical order by author at the end of a paper. The following form is used by most journals:

1. Book: Leopold, Aldo. A Sand County Almanac. New York: Oxford University Press, 1949, 10-20.
2. Encyclopedia: Wieschoff, H. Liberia. Encyclopedia Britanica, 1961, XIII, 1005-1008.
3. Periodical: Deutsch, M. A Theory of Cooperation and Competition. Human Relations, 1949, 2, 129-151.

C. Footnotes: Footnotes serve two purposes: (1) to give additional information or (2) to note exact source of material used. The first type appear at the bottom of the page and are identified by a superscript number.[1] The second type may appear paranthetically within the text as follows:

(Leopold, 1949)

Be sure all footnoted references are listed in your bibliography.

---

[1] Additional information can be obtained from your advisor or librarian.

A GUIDE TO USING THE SYRACUSE UNIVERSITY SCIENCE LIBRARIES

The students of the Advanced Science course are greatly encouraged to utilize the material available at Syracuse University in researching their particular topic. It will be here that you will be able to find the mist extensive studies, works and experiments which have been performed in any possible topic you can imagine. It is highly recommended that you and your advisor arrange a time for a field trip to the science library where your advisor and the librarian can give you a first hand explanation on using the resource material available.

One of the libraries which may be of help to many students is the Natural Science Library located in Lyman Hall. This library serves the biological sciences and geography. For the various other disciplines the libraries are located within the particular department, for example the Chemistry Library is located in Bowne Hall, the Geology Library in Heroy Hall, and the Physics Library in the physics building (newest).

General Organization of the Science Library in Lyman Hall.

The material in the library is shelved according to the Library of Congress classification system. The following is a list of the major Library of Congress subject divisions.

D	History and Topography
E-F	The Americas
G	Geography and Anthropology
H	Social Sciences
Q	Science
QC	Physics
QD	Chemistry
QE	Geology
QH	Natural History (Ecology)
QK	Botany
QL	Zoology
QM	Human Anatomy
QP	Physiology
QR	Bacteriology
R	Medicine
S	Agriculture
T	Technology
Z	Bibliography

Reserves: Reserve Books are shelved in closed stacks behind the Circulation Desk.

References: General references books such as encyclopedias, handbooks, foreign dictionaries, directories etc. are on open shelves directly across from the Circulation Desk. The symbol "Ref." or "R" indicates that these books are in the Reference collection.

Theses: Master Theses are available in each discipline and are located in the various libraries. Ph.D dissertations are available only on micro-film.

Pamplet Files: A collection of unclassified pamplet material is available and is grouped according to subject.

Periodical Room: Current unbound issues of frequently used periodicals are shelved in this room until reading for binding.

Library Resources: Tools for Locating Information

CARD CATALOG

All books and periodicals received by a library are listed in the card catalogs which constitute a key to their location. The catalog is divided into two alphabets (1) The author - title catalog contains cards for author, editor and often title. It should be remembered that an "author" may be corporate, as a government, a society, or an institution as well as an individual. (2) The subject catalog contains one or more subject entries for the material listed in the author catalog. It is important to know that a "subject" may be a person as well as a field of study. (3) The theses file is a separate author file listing theses by department, year, and author within the year as theses are arranged on the shelves.

ABSTRACTS AND INDEXES

In lieu of a Reader's Guide a Science Library has specialized indexes and abstracts to literature in the sciences. Allsuch indexes are together in one stack identified by the dictionary stand. (Remember that at this time the science library at Syracuse is divided according to disciplines and department therefore to find an index on a particular subject you have to go to the appropriate library) Special subject bibliographies whose call numbers are in the 000's (Dewey) or the Z's (Library of Congress) are shelved here also. An index list references with author's name, title of book, work or journal article, name of the periodical, volume, page reference and. An abstract in addition gives an annotated citation to current literature, noting contents in the form of a brief summary or a long review.

The following are common examples of both indexes and abstracts, remember these are only a few and should not be mistaken for a complete list.

Chemical Abstracts - a journal in the English language covering literature in every possible field and from every possible periodical in theoretical and applied chemistry.

The American Chemical Society Journal - an indexed collection of all the articles and publications complied by the A.C.S.

Biological Abstracts - a semimonthly journal with English abstracts covering literature in theoretical and applied biology from over 5,000 periodicals.

Botantical Abstracts - abstracts in the international field of botany.

Review of Applied Mycology - covers abstracts on applied mycology and plant pathology.

U.S. Atomic Energy Commission (Nuclear Science Abstracts) - covers articles, domestic and foreigh relating to atomic energy.

U.S. Fish and Wildlife Services (Wildlife Abstracts) - a bibliography and index of abstracts in wildlife review. Other publications which serve as guides to current research are shelved in the stacks with books on the same subject. They may be annual review serials such as:

Advances in cancer research
Advances in enzymology
Annual review of microbiology and many more

USE OF THE SCIENCE ABSTRACT

Each abstract should contain:

A) The title or other designation

B) The author's name

C) The reference in full

D) A brief summary of the main points or results brought together in the work.

The Purpose of the Abstract:

A) Abstracts enable an investigator who is seeking information on a subject to determine quickly whether the desired facts are contained in the article.

B) Abstracts provide a quick method of keeping informed of the trend of current scientific literature.

C) Abstracts give a brief resume of articles so that they made be read more intelligently.

The Science Abstract is utilized in much the same way as the Reader's Guide to Periodical Literature. The Abstract has a yearly subject and author index which enables you to find a particular abstract on a subject very easily. The index is only cumulative for one year at a time, therefore you must utilized a different index form each year. In the beginning of each index there is a guide on how to use the abstract. This should be consulted before you begin to do your research.

HOW TO USE THE READER'S GUIDE TO PERIODICAL LITERATURE

A student has decided to do a project concerning air pollution and he would like to find articles written in 1971 on this topic. He would therefore go to the 1971 Edition of the Reader's Guide and look in the subject index under air pollution (pollution, ecology, environmental problems) where he might find for example the following:

Air Pollution

Auto, exhaust, pollution and weather patterns (title of the article) adaption of the testimony before sub-committee on air and water pollution (content of the article) V.J. Schaefer (author) Bul Atom Sci. (title of the periodical) 26 (vol. Number)L 31-3 (page numbers), O (month) '70 (year)

After choosing the appropriate articles the student will write the name and date of the periodical on a call slip and submit this to the periodical room where he will receive the desired issue.

If the student decided to find other articles written by a particular author in a certain year he would follow the same process but in this case utilized the author index.

D) Special Index - These include listings of books and magazines or newspapers articles on a variety of special indexes. These are usually found on open-reference room shelves. Ex. The New York Times Index.

E) Bibliographies: some publications are actually bibliographies on certain subjects.

ADVANCED SCIENCE AND INDEPENDENT RESEARCH

Experimental Design and Hypothesis Testing

SCIENTIFIC METHOD OF TESTING: DEFINITIONS

Population - The sum total of factors or individuals to be described by the experimental data and conclusions.

Sample - A segment of the population, theoretically a small scale representation of the population being studied.

Statistics - Scientific method of analyzing mathematically populations or sample data to define their physical properties and characteristics.

Population Statistics - math manipulations to define populations by parameters.

Sample Statistics - math manipulations to study a segment of a population. Results of sample statistics can be used with varying degrees of confidence to describe the properties of the total population.

I. Sampling: Selection of a representative portion of a population

A) Random: A sample should be random to eliminate variables of bias

1. Cross-sectional sample - short term sampling
2. Longitudinal sample - long term sampling

B) Significant numbers: Samples must be constructed so it tests accurately the population; i.e. there must be a sufficient number within the sample.

II. Experimental Design: An experiment must be constructed so it tests for the desired outcome

A) Experimental Variables:

1. Independent Variables: The variable that is manipulated by the experimentor.
2. Dependent Variable: The variable that changes as a result of changes in the independent variable. Observations of this relationship leads to conclusions concerning the effect between the two variables.

B) Group Testing: Division of the elements of the sample to study the effects of the experimental variables.

1. Experimental Group: That portion of the sample which receives the independent variable.
2. Control Group: That group which is not presented, and therefore, effected by the independent variable. Statistical analysis betwen the two groups is a basis for determination of the effect of the variable begin studied.

C) Desgins for Hypothesis Testing

1. Pre-post Experimental Control Method: This method is one of the most common and best methods of conducting an experiment. Many alterations of the basic design can be applied to a variety of situations:

	Pretest	Independent Variable	Post test
Group 1 (Experimental)	X	0 (Ind. Var. Applied)	X
Group 2 (Control)	X		X

   a) Comparison of the groups performance on Post test may give indications of 0's effect.
   b) Pretest and Post-test may be the same or different tests; a test may be a measurement (i.e. height) or score on a quiz, time to react to a stimuli, or anything which may effect the element being studied. The time duration between Pretest and Post test may vary and the application of the independent variable (0) may be once, or any number of time, in the same or different concentrations, intensity, etc. In other words the above design must be constructed to best test the hypothesis being researched.
   c) Although many factors are controlled by this experiment, it is not a perfect design. Depending on the experiment and duration between testing, some outside factors may influence the groups results.

III. Statistical Properties of Experimental Data

A) Assigning Variables: Once the experiment has been devised, it becomes necessary to denote the variable(s) with symbols:

1. If only one variable or set of scores (data) is used, it is "X"
2. A second variable is denoted by "Y", a third "Z"

B) Collecting data: Data may be collected in a variety of ways (tests scores, measurements, etc.) and the design of collected method rests with the experimentor. However, data may be displayed in a number of ways both to provide computations for statistical formulae and easy observation of results. Data may be grouped or ungrouped.

1. Data Charts: Data may be displayed on a data chart:

a) Ungrouped

Item	Score
1	90
2	85
3	95
4	60
5	75
6	80
7	85
8	85
9	90
10	75

b) Grouped

Items	Score (Frequency)
90 - 99	3
80 - 85	4
70 - 79	2
60 - 69	1

2. Frequency Distribution: For use in various statistical tests (which are to be later discussed), it is necessary to measure and perform certain manipulations on experimental data. The common procedure is to place the data on a frequency table, a form of which is illustrated below:

Class Limits	Class Boundaries	f_i	x_i	$x_i f_i$	x^2_i	$x^2_i f$
90 - 99	89.5 - 99.5	3	95	285	9025	27075
80 - 89	79.5 - 89.5	4	85	340	7225	28900
70 - 79	69.5 - 79.5	2	75	150	5625	11250
60 - 69	59.5 - 69.5	1	65	65	4225	4225
	Σ (sum of) =	10	320	840	26100	71450

1. Class Limits: Arbitrarily chosen by experimentor from observation of data. Limits should divide the data into five of so groups.
2. Class Boundaries: One half unit below the lower limit; one half unit above the upper limit.
3. f_i: frequency or number of scores that fall within the class boundaries.
4. x_i: the midpoint of the class limits
5. $x_i f_i$: midpoint x frequency of a class group
6. x^2_i: the square of the midpoint
7. $x_i^2 f$: the square of the midpoint x the frequency of the class.

Coding and Coded Scores: Since the measurements of score (i.e. data) from an experiment may be many and of large numbers, it is often cumbersome and tedious to perform the above manipulations on all the numbers. Therefore, one may code the numbers, or change them to more workable terms. At this point in this unit, coding will be introduced but the formulae and applications will be at a later section. The basic reason for coding is to change the data to small numbers, work the statistical tests on these numbers, and then change the results back to actual dimensions The general method of coding is:

1. Observe the data and estimate the sample mean. It is helpful if this estimate is one of the midpoints.
2. Add another column to the frequency table: $x_i - A$; "A" being the estimate mean. Divided $x_i - i$ by the interval of the class boundary (upper boundary - lower boudary, for the above frequency table, 10)
3. This number derived from $\frac{x_i - A}{I}$ is called U

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The frequency table for the grouped tests scores then becomes:

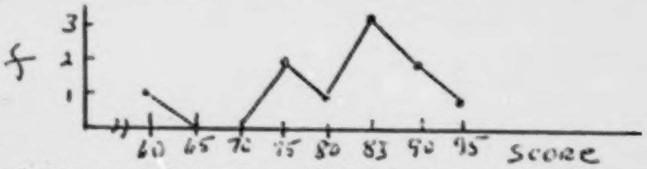
Class Limits	Class Boundaries	f_i	x_i	$\frac{x_i - A}{I}$	Uf	U^2	U^2f
90 - 99	89.5 - 99.5	3	95	1	3	1	3
80 - 89	79.5 - 89.5	4	85	0	0	0	0
70 - 79	69.5 - 79.5	2	75	-1	-2	1	2
60 - 69	59.5 - 69.5	1	65	-2	-2	4	4
		Σ = 10L		-2	-1	6	9

(In the example above the mean was estimated to be 85 (A = 85, and the interval is 10 (I = 10)

IV. Distribution of Data: Data may exhibit any number of types of distributions depending upon the experiment being conducted. One function of statistics is to mathematically described properties of data distribution. Graphs, in conjunction with frequency tables, are most helpful in data analysis.

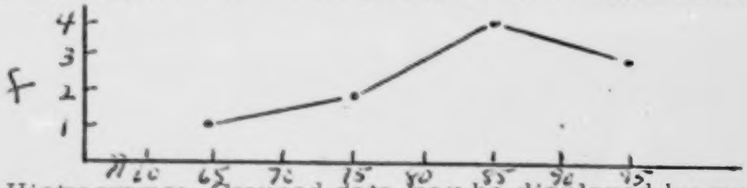
A) Graphs

1. Ungrouped data: From the data collected in an ungrouped manner two main types of graphs are useful:
   a. Frequency Polygon: From the data given in III B 1, the following frequency polygon may be constructed.

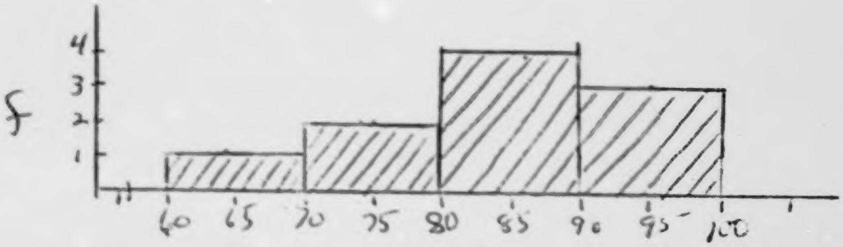


   b. This same data may also be represented by a scattergram.

2. Grouped data: From the data given in table III B 2, a frequency polygon may also be constructed: this uses the midpoints (X_i) as the y coordinates and the frequency as the x coordinates.

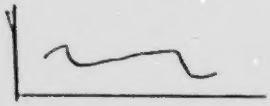


   b. Histrograms: Grouped data may be displayed by means of a histogram:

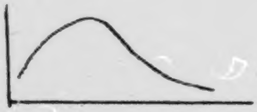


B) Types of distribution: Data when graphed may show different types of geometric symmetry.

1. Asymmetrical

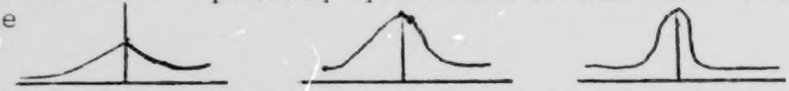


2. Skewed (as Chi Squres - χ^2)



3. Range (high value - low value)

4. Normal: A curve perfectly symmetrical on either side of a mean line



5. Standard Normal Curve: For purpose of estimating how normal a sample is or if a sample differs from the population from which it is a part of, or to find percentile ranks (where a score is in relationship to the others), or if two sample means are different significantly from each other (i.e., Post test Group 1 and Group 2), or percent of the population included by two numbers (confidence intervals), or a number of other statistical tests, we compare them to a normal curve of $\mu = 1$ and $\sigma = 1$. This is called the Standard Normal Curve. Use of this curse will be discussed later in this unit.

V. Statistical Measurements on Experimental Data: Group Tests

A) Population Statistics: When tests are made on all members of a population, the following population statistics are used.

1. Range: This is the high minus the low score
2. Mode: This is the score with the highest frequency. In grouped data it would be the midpoint of the interval with the highest frequency. Data may have more than one mode.
3. Medium or Median: This is the score of which 50% of the score are above it and 50% below. To find the median of grouped data the following formula is used.

$M = L + (\frac{S}{f})(i)$

L = lower boundary of interval which contain the middle score

S = scores needed to reach median

f = frequency of interval containing median

i = range of interval

4. Mean: This is the average value of the population. Represented by μ the formula is:

$$\mu = \frac{\sum x}{N}$$

6. Variance: Since the mean, median, and mode do not indicate the spread of data (i.e., 0, 5, 10 and 4, 5, 6 have the same mean) the variance and the standard deviation tell more above the "clusterness" of data. The variance is the mean (average) difference that scores have from the population mean squared. In other words determine the distance from the mean of each score $(x - \mu)$, square each of these $x - \mu$'s, sum them up and divide by N, the number of scores. (See frequency table below 6). The formula is:

$$\sigma^2 = \frac{\Sigma(x-\mu)^2}{N} \quad \text{or} \quad \sigma^2 = \frac{N\Sigma x^2 - (\Sigma x)^2}{N}$$

7. Standard Deviation: More useful in statistics is the standard deviation, represented by σ SIGMA. The standard deviation is the square root of the variance. The formula is:

$$\sigma = \sqrt{\Sigma(x-\mu)^2/N} \quad \text{OR} \quad \sigma = \sqrt{N\Sigma x^2 - (\Sigma x)^2}/N$$

Using the previous example of frequency distribution the above 6 tests will be run on the three main types of tables: Ungrouped, grouped, coded. Notice that the formula for the σ^2 and σ are the same, only the notation has changed.

UNGROUPED

	Item Score	
x	$(x - \mu)$	$(x - \mu)^2$
90	8	64
85	3	9
95	13	169
60	-22	484
75	-7	49
80	-2	4
85	3	9
85	3	9
90	8	64
75	-7	49
Σ	0	910

GROUPED

Class Limits	Class Bound	f_i	x_i	$x_i f_i$	x_i^2	$x_i^2 f$
90-99	89.5 - 99.5	3	95	285	9025	27075
80-89	79.5 - 83.5	4	85	340	7225	28900
70-79	69.5 - 79.5	2	75	150	5625	11250
60-69	59.5 - 69.5	1	65	65	4225	4225
			Σ	840	26100	71450

CODED

Class Limits	Class Bound	f_i	x_i	U	Uf	U^2	$U^2 f$
90-99	89.5 - 99.5	3	95	1	3	1	3
80-89	79.5 - 89.5	4	85	0	0	0	0
70-79	69.5 - 79.5	2	75	-1	-2	1	2
60-69	59.5 - 69.5	1	65	-2	-2	4	4
				Σ	-1	6	9

UNGROUPED	GROUPED	CODED
Range: 35	40	40
Mode: 85	85	85
Median: 85	$P_{50} = L + (\frac{S}{f})\, i$ $79.5 + (2/4)\, 10 = 84.5$	84.5
Mean: $\mu = \frac{\Sigma x}{N} = 82$	$\mu = \frac{\Sigma f x}{N} = 84$	N = $\frac{\Sigma f u}{N}$ =84 to decode $_{U}$ + A
Variance: $\sigma^2 = \frac{\Sigma (x-\mu)^2}{N}$ $\sigma^2 = 91$	$\sigma^2 = \frac{N \Sigma f (x)^2 - (\Sigma f x)^2}{N}$ $\sigma^2 = 89$	$\sigma^2 = \frac{N f(u)^2 - (\Sigma f u)^2}{N}$ $\sigma_x^2 = 89$
Standard $\sigma = \sqrt{\sigma^2}$ Deviation = 9.54	= 9.43	= 9.43

Summary of Statistical Formulae for Mean and Standard Deviation

	Mean	Standard Deviation	
		Raw Score	Mean Score
Ungrouped	$\mu = \frac{\Sigma x}{N}$	$\sigma = \sqrt{\frac{N \Sigma x^2 - (\Sigma x)^2}{N}}$	$\sigma = \sqrt{\frac{\Sigma (x-\mu)^2}{N}}$
Grouped	$\mu = \frac{\Sigma f x}{N}$	$\sigma = \sqrt{\frac{N \Sigma f (x)^2 - (\Sigma f x)^2}{N}}$	
Coded	$\mu_u = \frac{\Sigma f u}{N}$	$\sigma_u = \sqrt{\frac{N \Sigma f (u)^2 - (\Sigma f u)^2}{N}}$	
To "decode" coded answer:	$\mu_x = i \mu_u + A$	$N_x = i\, \sigma_u$	

B) Sample Statistics: When a portion of a population is being studied, sample statistics are used to predict properties of the population of which they consist.

1. Mode: Is the most frequent score of our sample
2. Median: Is the middle value of our sample. Determined in the same manner as a population median.
3. Mean: Represented by $\bar{X}$, this is the average score of our sample. It is found in the same manner as with a population μ, only the notation is different.

$$\bar{X} = \frac{\Sigma x}{N}$$

4. Variance: The same in meaning and method as the population, only the notation is different:

$$S^2 = \frac{\Sigma (x - \bar{X})^2}{N} \quad \text{or} \quad S^2 = \frac{N \Sigma x^2 - (\Sigma x)^2}{N}$$

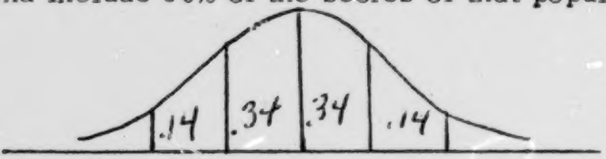
5. Standard Deviation: As with 1 - 4, only the notation is different:

$$S = \frac{\sqrt{N\Sigma x^2 - (\Sigma x)^2}}{N}$$

VI. Statistical Measurements on Experimental Data (Individual)

A) The Normal Curve and the Z Score: Using the mean and standard deviation of a sample or population, a Z score can be determined for individual scores within that sample or population. Z scores are used for a number of tests; percentile scores and t tests which will be discussed in this unit.

1. Explanation of the Standard Normal Curve: To understand Z scores it is necessary to explain the Standard Normal Curve. Since the SN Curve represents an infinite population, segments under portions of the curve represent the percent of elements within that given segment. For example 1 standard deviation on either side of the mean ($\mu = 0$) includes the scores of 68% of the elements of that population; 2 standard deviations cut off and include 96% of the scores of that population.



2. Therefore if one can determine an individual's Z score (that is how his score is in relationship to the population), he can determine his relative position within the population.

3. To transpose an individual's score to a standard score (that is, a Z score) the following formula is used:

$$Z = \frac{X - \mu}{\sigma}$$

The Z score will place the individual at some place on the Standard Normal Curve.

It can represent his percentile (the percent of individual within that population with a lower Z score)

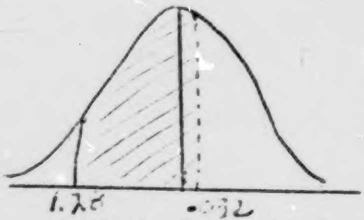
4. The Z score can be applied to a Z table to find out the percentile rank of an individual. Although there are different types of Z tables, all can be used for percentile ranks and probability.

5. For our previous examples a score of 90 has a Z score of $\frac{90-82}{9.4}$ = .085 and from the Z table a percentil rank - 53%
A score of 75 has a Z score of $\frac{75-82}{9.4}$ = .078 or a PR = 48%

6. Also using Z scores we can find the percentage of individuals from a population included between two scores: i.e., What percentage of the population is located between 70 and 85 from our example? Z table III is more useful for this type of test:

$$Z_{85} = \frac{85-82}{9.4} = \frac{3}{9.4} = .032$$

$$Z_{70} = \frac{70-82}{9.4} = \frac{-12}{9.4} = -1.28$$



Z	% Curve
.032	.012
-1.28	(-)-.399
	.411

B) t Tests: One of the most important statistical test is the t test. This is used to determine if a score (or group of scores) differed significantly from the expected; or if two mean (i.e., Post test - Group 1 and 2) are significantly different.

1. Independent Different (Population)
   a) Since a Z score of ± 2 cuts off 95% of the population, there is a 4% chance that a score will fall outside of this interval. Therefore it can be assumed that about 1 chance in 20 a score which belongs to a population will exceed a Z or either +2 of -2.
   b) Researchers use the principle to determine that a score is significantly different from the population of which it may be assumed it is a member. However, they use a 95% confidence interval (Z = ± 1.96) or a more strict 99% interval (Z = ± 2.58). (95% = $\alpha .05$; 99% = $\alpha .01$)
   c) Using a and b above we can formulate hypotheses to state that a given variable will or will not effect a score (i.e., not cause it to exceed a given confidence interval).
   d) A hypothesis is stated in negative terms; this is called the null hypothesis: For example treatment "A" has no effect on the subjects.
   e) A confidence interval is stated (i.e., $\alpha = .05$) and a t test run on the score(s). Is the Z score within the interval we accept the null hypothesis: there is no difference (with 95% certainly); if the score(s) fall outside the interval, they we reject the null hypothesis; there is a significant difference (caused by threatment A).

VII. Statistical Measurement of Experimental Data (Group): More often than not in experimental science tests are run of group differences to determine significant differences. As with individual tests the hypothesis is stated in the Null form.

A) Sample Statistics - t testing

1. In the examples thus far we have assumed populations with infinite numbers. In these cases the t test was actually Z scores.
2. However when a segment of the population is under study, the confidence interval (i.e., critical t values) will vary with the sample number; the smaller the sample the larger the interval (i.e., the larger the t value must be to have a significant difference) and the larger the sample the smaller the interval, with the t value approaching the Z value of 1.96 or 2.58 (see t tables at the end of this unit).
3. To determine how large a t value must be to be critical, we use a t table. This incorporates degrees of freedom. It is the number of (group 1 plus group 2) - 2.

*4. There are a number of formulae to arrive at a t value.

B) Example of experimental design and hypothesis testing:

1. Purpose: to determine the effect of IAA on stem length in the red kidney bean.
2. Hypothesis: IAA in the concentration 10-5M will have no effect on stem length in the red kidney bean.
3. Materials: List materials
4. Procedure: Population or sample used, Experimental Method
5. Data Collection:
6. Results: Graphs, Statistical tests.
7. Conclusions: Did the results lead to acceptance or rejection of the experimental hypothesis.

These ten pages and few tables are only a small part of the science of statistics. Perhaps this introduction will be of value during the course of your experiments. It does illustrate the basic types of statistical procedures and the basic tests and types of frequency tables. However, data which you collect may have to use modification of the basic designs showed here. t test and Z scores as presented here were in a very simplified form. If your experiment needs this test, a basic text on statistics can be obtained from the library or your math teacher. From source books the test applicable to your data can be determined.

In addition to the tests presented in this unit some of the other major types of analysis are:

1. Chi Squarted (χ^2): This test determines significance between expected and observed results.

2. Correlations: Correlation statistics will illustrate the amount of relationships and dependence between two variables.

3. Analysis of variance: This will show if there are relationship among a series of experimental means.

4. Many others may exist but may require the use of a computer. Again, if your experiment is such that it needs computer analysis of data, approach your advisor for help.

CHEMISTRY RELATED PROJECTS

1) Building of an Oscilliscope

2) Crystal growing

3) Electroplating

4) Photography

5) Effect of Chemical Nutrients on Plant Growth

6) Survey of pH Changes in Various Bodies of Water

7) Effect of certain vitamins/hormones on Animal Behavior

8) Construction and use of a Calorimeter

9) Plastics and Synthetics

10) Study and Production of Various Polymers

11) Wave Mechanics*

12) Organic synthesis of Compounds and the Subsequent Testing for Purity and % Yield, (alcohol, ketones, aldehydes, proteins, enzymes, etc.)

13) Substitution Reactions in Aromatic Compounds

14) Chromotography

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Chromotography of Inorganic Compounds

- a) Elements
- b) Ions of the metals
- c) Anions
- d) Cations
- e) Purification of Inorganic compounds
- f) Isotopes

Chromotography of Organic Compounds

- a) Aliphatic Compounds (hydrocarbons, fats, amino acids)
- b) Terpenes
- c) Benzene derivitives
- d) Aromatic-aliphatic compounds
- e) Condensed polycylic compounds'
- f) Sterols
- g) Heterocyclic nitrogeous bases
- h) Fat-soluble vitamins
- i) Water-soluble vitamins
- j) Hormones
- k) Enzymes, co-enzymes, proteins
- l) Chlorophylls
- m) Derivitives of Hemoglobin
- n) Bile pigments
- o) Carotenoids
- p) Coal-tar dyes

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BIOLOGY RELATED PROJECTS

1) Radiation and seed development
2) Magnetism and plant growth
3) Temperature and algae growth (or duck weed)
4) Oxygen concentration and algae growth
5) Minteral concentration (and pollution) and algae growth
6) Noise pollution and mouse behavior (fish behavior)
7) Soil pH and plant growth
8) Rate enzyme activity - isolation of enzyme
9) Vitamin deficiencies and mouse growth (gerbil)
10) Light wave length (color) and animal behavior
11) Throxin and tadpole development
12) Hormones and insect (mealworm) metamorphosis
13) Mutations in fruit flies
14) Factors that affect rate of fermentation - yeast
15) Factors that affect rate of photosynthesis
16) Factors that affect rate of respiration - mouse
17) Chemical analysis of a stream
18) Biological assay of a pond or stream
19) Water quality south and north ends of Onondaga Lake compared
20) Hormone concentration and plant development
21) Fish toleration of various types pollution.

PLANT PHYSIOLOGY LABS

Ecology Related Experiments

A. Mineral Deficiency Experiments using Nutrient Solutions
B. Absorbtion and Movement of Minerals - Radio tracing
C. The Effect of Light and Moving Air on Transportation
D. Action Spectrum of Chlorophyll
E. Starch and Photosynthesis in Leaves
F. Water Loss from Plants
G. Evolution of Carbon Dioxide

INDEX TO RESEARCH PROBLEMS IN BIOLOGY - SERIES 1, 2, 3, and 4

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II. Relationships of Living and Non-Living Things in the Ecosystem

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RESEARCH PROBLEMS IN BIOLOGY - SERIES 3

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93. The Influence of Environment on Cystoplasmically Inherited Pollen Sterility in Maize - pg. 53
94. Populations of Milkweek Beetles - pg. 56
96. The Soil Microflora and the Growth of Conifer Seeds - pg. 66
107. The Role of Competition in Determining the Intensity of Natural Selection - pg. 108
111. Growth and Spread of an Insect Population - pg. 131
113. Some Interrelationships between Photosynthesis and Bioluminescence - pg. 141
117. Ecology of Attached Bacteria in Water - pg. 158

RESEARCH PROBLEMS IN BIOLOGY - SERIES 4

Ecology Related Experiments

125. Environment and the Genus Chenopodium - pg. 19
129. The Physiological Ecology of Mosses - pg. 49
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135. Water Relations of Tree Seedlings - pg. 81
137. Local Floras - pg. 89
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151. Studies on Foraging and Learning in Ants - pg. 162
155. The Toxicity of Synthetic Detergents on Fish - pg. 178
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159. Structural Effects of Low Temperature on a Ciliate Protozoon - pg. 196
160. Experiments in Mannaliam Hibernation - pg. 200

ENVIORNMENTAL POLLUTION

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3. Carbon Dioxide in Water - pg. 27
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5. The Production of Carbonhydrated by Producers - pg. 167
6. Carbon Dioxide and Photosynthesis - pg. 168
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8. Bacteria in Water: Coliform Counts (The Hach Coliver Method) pg. 172
9. Bacteria in Water: Coliform Counts (Membrane Filtration)
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14. Acidity
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16. Total Dissolved Solids - pg. 186
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18. Volume of Flow - pg. 190
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24. Field Trip to a Small Lake - pg. 197
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ENVIRONMENTAL POLLUTION

Ecology Related Experiments

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17. Classroom Experiment: Habitat Selection - pg. 125
18. An Experimental Food Chain for the Laboratory - pg. 127
19. Field Trip to a Pond or Small Lake - pg. 145
20. Field Trip to a Stream - pg. 149

TURTOX SERVICE LEAFLETS

The 60 leaflets below contain information on setting up experiments on various topics. Some contain bibliographies to start you on further research in a certain subject area.

All 60 leaflets are located in the Biology file cabinet and are readily obtained by request.

#1. How to Make an Insect Collection.
#2. Preserving Zoological Specimens.
#3. Preserving Botanical Specimens.
#4. The Care of Protozoan Cultures in the Laboratory.
#5. Starting & Maintaining a Freshwater Aquarium.
#6. Growing Fresh-water Algae in the Laboratory.
#7. The Care of Frogs & Other Amphibians.
#8. How to Prepare Microscope Slides to Simple Objects.
#9. How to Make Skeletons.
#10. The School Terrarium.
#11. Plants for the Fresh-water Aquarium.
#12. Demonstration & Display Materials.
#13. Rearing the Silkworm Moth.
#14. A Selected List of Books for the Biology Library.
#15. The Culture of Drosophila Flies & Their Use in Demonstrating Mendel's Law of Heredity.
#16. The Culture of Planaria & its Use in Regeneration Experiments.
#17. Incubation, Fixation & Mounting of Check Embryos.
#18. Insectivorous Plants.
#19. Special Projects for Biology Students.
#20. Chromatography.
#21. The Embalming & Injection of the Cat & the Laboratory Care of Embalmed Specimens.
#22. How toMake Laboratory Drawings.
#23. Feeding Aquarium & Terrarium Animals.
#24. Preparing & Caring for a Herbarium Collection.
#25. Non-flowering Plants.
#26. Making Biology Charts.
#27. Brine Shrimp & Other Crustaceans.
#28. Reptiles in the School Laboratory.
#29. Blood typing.
#20. Gowing Plants in Nutrient Culture Media.
#31. Physarum Polycephalum & Dictyostelium Discoideum.
#32. The Culture & Microscopy of Molds.
#33. Embedding Specimens in Transparent Plastic.
#34. The Care of Living Insects in the School Laboratory.
#35. Studying Ants in Observation Nests.
#36. Practical Microscopy.
#37. Flowering Plants in the Laboratory.
#38. Moth Cocoons.
#39. The Fresh-water Hydras.
#40. The Care of Rats, Mice, Hamsters and Guinea Pigs.
#41. Collection & Culture of Earthworms & Other Annelids.
#42. Laboratory Dissections.
#43. Embryology in the High School Biology Course.
#44. Growing Fern Prothallia in the Laboratory.
#45. Lantern Slides any Teacher can Mak
#46. The Study of Fossil Specimens.
#47. Plant Experiments with Gibberellic Acid.
#48. Aquarium Troubles: Their Preventio & Remedies.
#49. Nutrition Experiments.
#50. Elementary Experiments in Bacteriology.
#51. Hydroponics: Growing Plants in Nutrient Solutions without Soil.
#52. Advanced Experiments in Bacteriology.
#53. Experiments in Radiobiology.
#54. Plant & Animal Hormone Experiments
#55. Injecting Vertebrate Specimens.
#56. Simplified Photomicrography.
#57. The Organization & Activities of a Biology Club.
#58. Measuring with the Microscope.
#59. Basic Laboratory Equipment for the High School Biology Course.
#60. Plant Culture with Artificial Light.

EAST SYRACUSE-MINOA SCHOOLS

Environmental Education Materials

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An Ecology Course

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ECOLOGY

A HIGH SCHOOL COURSE

1973-74

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DEVELOPED BY

Mr. Joseph McGrath

Mr. Donald Parker

Mrs. Mary Pinkerton

TABLE OF CONTENTS

Course outline

Course timetable

Requirements (for student)

UNIT I: BIOTIC INTERRELATIONSHIPS

Each unit contains:

- objectives
- correlation chart (objectives, activity, resources)
- activities (lab, worksheet, film, etc.)
- unit test

UNIT II: AIR QUALITY

UNIT III: WATER QUALITY

UNIT IV: OTHER ECOLOGY RELATED PROBLEMS

Bibliography:

- books
- taxonomic keys
- magazines
- films & filmstrips
- additional sources of information

TOPICAL OUTLINE

I. BIOTIC INTERRELATIONSHIPS

A. INTRODUCTION

1. Biotic vs. Abiotic
2. Levels of Organization

B. COMMUNITIES (QUAD STUDY OF BIOTA)

1. Plant identification
2. Layering
3. Soil organisms
4. Invertebrate identification
5. Vertebrate identification
6. Food webs
    a. niches (producer, consumer, decomposer, etc.)
    b. terrestrial
    c. aquatic
7. Symbiosis (parasitism, mutualism, commensalism)

C. ECOSYSTEMS (EFFECTS OF ABIOTA ON BIOTA)

1. Photosynthesis & respiration
2. Flow of Energy
3. Succession & Eutrophication
4. Natural Cycles (Nitrogen, Oxygen, Water)
5. Other Abiota (Oxygen, Temperature, Rainfall, Soil, Sunlight, etc.)

D. BIOMES (TUNDRA, TAIGA, TEMPERATE, TROPICAL, DESERT, OCEAN, ETC.)

E. POPULATIONS

1. Growth curves
2. Limiting factors
3. Human population
4. Behaviors
    a) societies
    b) biological clocks
    c) territorialism
    d) instincts

II. AIR QUALITY

A. COMPOSITION OF NORMAL AIR

1. Gases (N_2 & O_2)
2. Cycles (N, CO_2, O_2)

B. SOURCES OF AIR POLLUTION

1. Automobile (CO, SO_2, NO, HC)
2. Industry (particles & gases)
3. Furnaces & space heaters
4. Natural (volcano, swamp, erosion, pollen)

5. Waste incineration (soot, fly-ash)

C. AIR CONTAMINANTS (SOURCES & DAMAGING EFFECTS)

1. Particles (aresols, soot, fly ash, dust)
2. Sulfur oxides (SO_2, H_2SO_4, H_2S)
3. Nitrogen oxides (N_2O, NO_2, NO, HNO_3)
4. Carbons (carbon dioxide, carbon monoxide, hydrocarbons)
   CO_2 CO H-C

5. Ozone (O_3)

6. Others (Pb, F, Asbestos)

D. AIR POLLUTION AND WEATHER

1. Temperature inversion
2. Photochemical (L.A.) smog
3. Particulate (London) smog

E. PREVENTION

1. Control devices
   a. electrostatic precipitator
   b. dust collector
   c. spray tower (scrubber)
   d. absorption filter
   e. limestone filter
   f. auto emission devices
2. Legislation
   a. E.P.A. standards
   b. open burning bans
   monitoring devices
3. Alternatives for fossil fuel
   a. nuclear (breeder) reactor
   b. steam turbine car, etc.
   c. mass transport (electrical)

III. WATER QUALITY

A. SOURCES OF FRESH WATER POLLUTION

1. Sewage
2. Chemicals from industry
3. Heated water from nuclear reactors
4. Phosphates from detergents
5. Agriculture run-off (pesticides & fertilizers)
6. Air contaminants (rain & fall-out)
7. Solid wastes (dump seepage)

B. MEASURING BIOTIC POTENTIAL

1. Dissolved oxygen
   a. temperature
   b. algae
   c. phosphates

        - d. light penetration
    - 2. Phosphates, nitrates, & eutrophication
    - 3. Coliform
    - 4. B.O.D. (biological oxygen demand) & C.O.D. (chemical oxygen demand)
    - 5. Relationships between: sulfates, chlorine, carbon dioxide, pH, & hardness
    - 6. Metallic ions
    - 7. New York State. Classification of water & standards.

C. HAZARDS OF POLLUTANTS TO LIFE (WILD LIFE & HUMAN)

1. diseases
2. accumulation of toxins
3. suffocation
4. imbalanced food webs
5. imbalanced cycles (CO_2 - O_2, nitrogen, water)
6. eutrophication

D. AQUATIC SANITATION

1. Natural purification
2. Primary sewage treatment (physical)
3. Secondary sewage treatment (biological)
4. Tertiary sewage treatment (chemical)
5. Hot water holding tanks
6. Laws banning DDT, phosphates, etc.
7. Local facilities (Onondaga Co.)

E. MARINE POLLUTION

1. Ocean sink for all land, air, and freshwater contamination
2. Sewage from coastal cities
3. Chemicals from soastal industry
4. Thermal pollution
5. Oil spills
6. Accumulation of toxins along food web
7. Agricultural run-off

IV. OTHER ECOLOGY RELATED PROBLEMS

A. LAND POLLUTION

1. Solid wastes - examples and sources
2. Chemical wastes - examples and sources
3. Alterations of landscape
4. Solutions (pros & cons of each)

B. ENERGY CRISIS

1. Natural resources in short supply
2. Forms of energy production
3. Solutions (pros & cons)

C. ENDANGERED SPECIES

   1. Extinct species
   2. Nearly extinct species
   3. Causes
   4. Prevention

D. NOISE POLLUTION

   1. Types of noise & sources
   2. Mechanics of sound
   3. Health hazards

E. LEGISLATION CONCERNING THE ENVIRONMENT

   1. Federal laws & agencies (EPA)
   2. N.Y.S. laws & agencies (DEC)

COURSE TIME TABLE *

Sept. & Oct.

INTRODUCTION
COMMUNITIES (QUAD, FOOD WEB, SYMBIOSIS)
6 wks.

Nov. & Dec.

ECOSYSTEMS (PHOTOSYNTHESIS, SUCCESSION, CYCLES)
BIOMES
5 wks.

Dec. & Jan.

POPULATIONS - 5 wks.

Jan. & Feb.

AIR QUALITY - 6 wks.

Mar. - April - May

WATER QUALITY - 10 wks.

June

LAND POLLUTION
ENERGY CRISIS
ENDANGERED SPECIES
NOISE POLLUTION
LEGISLATION & AGENCIES
4 wks.

* Based on 3 periods (45 min.) each week for 2 semesters.

ECOLOGY COURSE REQUIREMENTS

NOTEBOOK: Since you will receive many dittos, recording long-term lab observations and sometimes taking notes, you will need a 3-ring loose leaf notebook to keep everything in order.

HOMEWORK: You will be penalized for any late homework assignments. Homework will be posted on Monday for the entire week. It's your responsibility to copy down assignments and have them done on time.

ABSENCE: You will be penalized for all "skips" by detention after school and will not be permitted to make up that day's work. People legally absent can check the assignment sheet for make-up work.

LABS: The course will involve much lab work and outdoor investigations. Lab reports will include:

purpose - Why you are performing this investigation.
prediction - What are the expected results?
data - Graphs, charts, tables, drawings, etc. to display your observations.
interpretation - answer prepared questions or write a summary explaining results. Form hypotheses to interpret observations. Include sources or error and limitations of your data.
conclusion - Make a final statement of why whatever happened, happened.
references - List all books, people, films, etc., to which you referred.

Lab reports will be marked and 5 points will be deducted for every day they are late.

GRADES WILL BE BASED ON:

Lab Reports
Announced full period tests (6 wk. test)
Unannounced, suprise quizzes
Project - 1/3 of final mark
Worksheets and homework assignments
Oral reports
Cooperation
Effort shown

ECOLOGY PROJECT

During the second semester each student is required to investigate a problem in depth. The student selects his own problem, shows its relevance to ecology, and starts investigation as soon as his teacher gives approval.

Many project ideas are suggested throughout the course. Extensions of most labs are potential projects also. Research must be gathered in an unbiased, scientific manner, and could take the form of a lab experiment, outdoor observations, survey, photography, letter writing, campaign, etc. This is not a term paper or report.

The preceeding lab format will be followed when writing the final report which is due 2 weeks prior to the exam.

Each student will also make a brief oral report of his findings to the class.

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I. BIOTIC INTERRELATIONSHIPS

ACTIVITY	TIME	OBJECTIVES	OUTLINE	RESOURCES
Worksheet: Introduction	1 period 1 hwk.	1, 2, 3	A	N.Y.S. Regents Biology Syllabus
Field Trip-walk along environmental studies area on campus.	1 period	1, 4, 5, 9, 11.	A & B	E.S.A. Booklet:* Trail guides
Film: Plant & Animal Communities: Interrelationships (14 min.)	1/2 per.	5, 6, 7, 8, 10.	B - 6 & 7	S.U. Film Lib. $8.00
Lab: Quadrat Studies I. Selection II. Plant Identification III. Layers & Profile IV. Soil Analysis V. Invertebrates VI. Vertebrates	6 per. 6 hwk.	4	B. 1-5	1. E.S.A. Booklet: "Plant Classification & Identification" "Layering & Soil Analysis" Taxonomic Keys- see bibliography 2. *E.P. pp. 2-18 3. B.S.C.S. Green Version
Film: Community (11 min.)	1/2 per.	5, 10.	B.6-7	S.U. Film lib. $4.25
Notes: Food Web Niches	1 period 1 hwk.	5, 6, 7, 8, 9.	B.6.	1. *F.W.E. pp.2-13, Chap.3. 2. B.S.C.S. Green version pp.28-30. 3. B.S.C.S. Yellow Version pp.695-700. Aquatic Food Web Quiz
Quad Study VII Food Web (terrestrial)	1 hwk.			
VIII Food Web (Aquatic)	1 period 1 hwk.			
Film: The Spruce Bog (23 min.)	1 period	5, 6, 10	B.6-7.	B.O.C.E.S. Film Lib. (free)
Filmstrip: Symbiosis	1 period 1 hwk.	10, 11, 12, 13.	B.7.	1. E.S.M. Sci. Dept. 2. B.S.C.S. Green Version pp.83-88. 3. E.S.A. Booklet: "Symbiosis Packet" 4. Film: Strange Partners 5. Comstock, A Handbook of Nature Study 6. N.Y.S. Conservation Dept. Information
Lab: "Identifying Live Parasites" (frog, mouse, etc.)	2 periods 1 hwk.			
Optional Lab "A Lot of Gall"	1 period 1 hwk.			
Notes: Symbiosis	1 period			

*E.P.=Environmental Pollution

*F.W.E.=Fresh Water Ecology

*E.S.A.= Environmental Studies Area on ESM Campus

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ACTIVITY	TIME	OBJECTIVES	OUTLINE	RESOURCES
				Leaflet "Some Architects of the Insect World" Ap.-May '62 7. Stock & Bancheri, Investigations in Modern Biology p.201. 8. Unit Test A & B outline
Notes: Photosynthesis: (light & dark phases)	1/2 per. 1 hwk.	14, 15, 16.	C.1 & 2	1. F.W.E. pp.23-24 2. B.S.C.S. Yellow version Ch.15. 3. Knight pp.168,189, 193
Lab: "Aquatic Environments & Dissolved Oxygen."	2 per. 1 hwk.	17, 18, 19		
Lab: "Index Algae"	2 per. 1 hwk.			
Optional Lab: "Relative Productivity"	2 per. 1 hwk.			4. E.S.A. Booklet: "Procucers in a Community"
Notes: Succession	1/2 per. 1 hwk.	16, 17, 18.	C.3.	1. F.W.E. pp.57-59. 2. E.S.A. Booklet "Plant Succession" "Biological Succession" "Succession in a Fresh Water Ecosystem" 3. S.U. Film Lib. $7.00 4. B.S.C.S. Yellow Vers. pp.218-221 & 701-703.
Lab: "Succession on a Slide"	2 per. 1 hwk.			
Film: Plant & Animal Communities: Ecological Succession	1 period 1 hwk.			
Notes: Cycles-Nitrogen, Carbon-Oxygen, Water	1 1/2 per. 1 hwk.	19, 20, 21.	C.4-5.	1. B.S.C.S. Yellow Vers. 686-697. 2. F.W.E. p.12.
Film: Plant & Animal Communities: Physical Environment (11 min.)	1/2 per.			3. S.U. Film Lib. $6.50
Discussion: Recycling Film-Realities of Recycling (38 min.)	1 period			4. School of Forestry Film Lib. (free)

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ACTIVITY	TIME	OBJECTIVES	OUTLINE	RESOURCES
Notes: Biomes	1/2 per.	22.	D.	1. B.S.C.S. Green Version pp.250-337 esp(282)
Optional Lab: "Temperature, Rain, & Biome Distribution" p.282 (Green Version)	1 hwk.			
Film: High Arctic Biome (22 min.)	1/2 per.			2. School of Forestry Film Lib. (free)
				Unit Test on C & D' of Outline
Worksheet: "Population Studies"	1 period 1 hwk.	23, 24, 25.	E.1-2	1. Knight pp.16-19 2. Odum pp.88, 201, 193
Lab: "Population Explosion"	5 per. 1 hwk.			
Optional Lab: "Population Changes" (Green Version)	1 hwk.	23, 24, 25.	E.1-2	3. B.S.C.S. Green Vers. 4. E.S.A. Booklet: "Population Explosion," "Population Change," "Fluxuation in a Microcommunity."
Worksheet: "Sampling" & Optional Lab: "Crowding in Populations."	1-3 per. 1 hwk.			
Film: Boomsville (10 min.)	1/2 per.	26, 27	E.3.	School of Forestry Film Lib. (free)
Discussion Sheet: "Human Population"	1 period 1 hwk.	26, 27	E.3.	Erlich, The Population Bomb
Film: Multiply & Subdue (67 min.)	2 per.	26, 27	E.3.	School of Forestry Film Lib. (free)
Filmstrip: "Animal Societies"	1 period 1 hwk.	28	E.4.	1. B.S.C.S. Blue Vers. Chap. 28. 2. Knight pp.139-142
Optional Filmstrip: "Biological Clocks"	1 period	29	E.4.	1. Lorenz, On Aggression 2. Barnett, Instinct and Intelligence 3. Ardrey, Territorial Imperative 4. Richard, Mystery of Animal Migration
Notes: "Territorialism"	1/2 per.			

ACTIVITY	TIME	OBJECTIVES	OUTLINE	RESOURCES
Optional Lab: "Territorialism"	1 hwk.	29	E.4.	B.S.C.S. Green Vers. p.561.
Optional Lab: "Territorialism & the Red-wing"	1 period	29	E.4.	E.S.A. Booklet
Oral Reports-Animal Behaviors	2 per.	29	E.4.	Filmstrips: "Animal Communication" & "Animal Navigation"
Film: Animal War, Animal Peace (30 min.)	1 period	29	E.4.	B.O.C.E.S. Film Library
Film: Plant and Animal Communities: Changes in the Balance of Nature (11 min.)	1/2 per.	1-29	A, B C, D E.	S.U. Film Rental ($6.50)
				Unit Test on Part E of outline

II. AIR QUALITY

ACTIVITY	TIME	OBJECTIVES	OUTLINE	RESOURCES
Set up Air Analysis Experiments #1,2,& 3. 3-4 weeks prior to this unit.	1 period		C_1 + 2	1. E.S.A. Booklet: "Air Analysis Lab Packet" "Bacterial Analysis of Air" 2.*E.P. Ch. 4 & 7 3. Dunbar, "Testing for Pollution," U.S. Dept. Agriculture (study aid #5) 4. Selected Methods for the Measurement of Air Pollutants, U.S. Dept. H.E.W. Public Service Publication #989 - April
Worksheet: "An Introduction to Air Pollution"	1 period 2 hwk.	1, 2, 3	A	1. E.P. pp.90-94, 96-99 2. Battan, L. The Unclean Sky, Doubleday, 1966. 3. Conservationist, "Pollution: An Environmental Crisis," leaflet #195
Demonstration (optional) "Incomplete Combustion"	1 period	5, 6, 10, 11.	B_1	E.P. p.100: #3
Filmstrip: Environmental Pollution: Air Pollution	1 period 1 hwk.	1, 2, 3, 4, 5, 6, 7, 9, 15	A,B,E	Wards: 70W 3800
Experiment #1: "Sticky Tape Observation" Notes: Particulate Matter (airborne)	1 period 1 hwk.	7, 8	C_1	1. E.P. pp.101-105 207-209 2. Environmental Activities News Bulletin, Vol. 1, no.2, March '72.
Experiment #2: "Dust-fall Jar"	2 per. 1 hwk.	7, 8	C_1	E.P. pp.202-204, 105-106,Ques.p.105: 1 & 3.
Experiment #3: "Nylon Disintegration"	1 period	7, 8, 9	C 2+3	

*E.P.=Andrews, Envirmental Pollution

ACTIVITIES	TIME	OBJECTIVES	OUTLINE	RESOURCES
Notes: Nitrogen & sulfur oxides	1 period	7, 8, 9		E.P. pp.119-122, 106-112
Demonstration (Optional) SO_2 Demonstration (Optional) NO_2	1 period	9	C 2+3	E.P. p.112: #3 p.123: #2
Experiment #4: "Density of Smoke" & Field trip to local industries	1 period 1 hwk.	7, 8, 11	C_1	Public Relations Div. of Carrier, Bristol, Allied Chemical, Crucible Steel, Jamesville Cement, General Electric, etc.
Notes: Carbon dioxide, carbon monoxide, hydrocarbons	1 period 1 hwk.	6, 9, 10, 11	C_4	E.P. pp.113-118, 124-126, 126: #3
Film: With Each Breath (30 min.-free)	1 period	1, 3, 9	A, B, C	National Medical A-V Center, Station K, Atlanta, Georgia 30324
Notes: Ozone, lead, flourides, asbestos.	1 period 1 hwk.	9	C 5+6	E.P. pp.127-133
Worksheet: "Weather & Air Pollution" (smogs)	1 period 1 hwk.	12, 13, 14	D	1. E.P. pp.134-136, 139-143, 2. Conservationist, "The Contaminated Air," Zimering, Oct.-Nov.'69
Demonstration (Optional) Temperature Inversion	1/2 per.	12	D_1	E.P. p.230.
Optional Lab #7.9 "Effects of Oxides on Various Materials"	2 per. 1 hwk.	9	C	E.P. p.230.
Worksheet: "The Pollution Solution: Prevention" Demonstration (op) Electrostatic Precipitator	1 period 1 hwk.	9, 15	E	1. Family Health, "How to Live with Air Pollution," McCleary, Aug. '71 2. E.P. p.232. 3. Singh, J. Air Pollution, Pollution Dynamics Corp. 1969

ACTIVITIES	TIME	OBJECTIVES	OUTLINE	RESOURCES
Film: Pollution: A Matter of Choice (52 min.)	2 per.	9, 15	E	School of Forestry (free)
Notes: E.P.A. standards for ambient air	1/2 per.	9, 15	E_2	1. E.P.A. Federal Register: "Ambient Air Quality Standards," vol. 36, no. 84, Part II, 4/30/71 2. E.P. pp.144-148.
Field Trip: Regional Testing Lab (Air, Water, Milk, Fuel)	1/2 day	16		For Central N.Y.: Mr. Jones 667 S. Salina St. Syracuse, N.Y.
Unit Test II Air Quality	1 period	1-15		
	per.19-24 weeks 6-8			

IV. OTHER ECOLOGY RELATED PROBLEMS

ACTIVITY	TIME	OBJECTIVE	OUTLINE	RESOURCES
Film: What on Earth? (10 min.)	1/2 per.			School of Forestry Film Lib. (free)
Notes & Filmstrip: "Environmental Pollution: Solid Waste Pollution"	1 period 1 hwk.	1, 2, 3	A	1. Wards 70W 3800 2. E.P.A., "Sanitary Landfill-An Answer to a Community Problem," Public Health Service Bull. #1012.
Film: The Stuff We Throw Away (22 min.)	1 period 1 hwk.	6, 7, 8	B	School of Forestry Film Lib. (free)
Film: Realities of Recycling (38 min.)	1 period	1, 2, 3, 6, 7, 8	B	Natural Wildlife, Oct. '71 Sci. Amer. Oct. '71 Conservationist Aug. '71 Forestry (free)
Worksheet: "Natural Resources"	1 period 1 hwk.	4, 5	B	1. Newsweek Magazine May 21, 1973 2. Mitchell, Ecotactics (Sierra Club) 3. Swater, Ecology Handbook
Notes: Endangered Species	1 period	9, 10	C	1. Natural History, Ap. '71 2. Senior Scholastic, March 15, 1971 3. National Parks & Conservation Magazine, Ap-May-Aug '71 4. Science Digest, Aug. '71 5. E.S.A. Booklet: "Forestry Packet"
Notes: Noise Pollution Information Sheet on Noise.	1 period 1 hwk.	11, 12, 13	D	1. Good Housekeeping Aug. '71 2. Science News, Mar. 18, 1972 3. Science News, July 15, 1972 4. Field & Stream, Nov.'71 5. Baron, The Tyranny of Noise.
Film: Down Decibel Down (11 min.)	1/2 per.	11, 121 13	D	School of Forestry

ACTIVITY	TIME	OBJECTIVE	OUTLINE	RESOURCES
Notes: Federal & State Legislation & Agencies	1 period	14, 15, 16	E	1. Environmental Protection Agency (EPA), various publications. 2. N.Y.S. Dept. of Environmental Conservation, various publications
Filmstrip: Environmental Pollution: "Pollution Control"	1 period 1 hwk.	17.	IIE IIID IVA	Wards 70W 3800
Film: Ah, Man See What You've Done (20 min.)	1/2 per.	2, 4, 9	B	School of Forestry
Ecodecisions Game: Silver Lake	2 per. 1 hwk.	18	E	1. Jones, "Master Plan for the Adirondacks," Conservationist, Oct.-Nov. '72. 2. Toffler, Future Shock.

UNIT I

BIOTIC INTERRELATIONSHIPS

COMMUNITIES	15 periods
ECOSYSTEMS	12 periods
POPULATIONS	15 periods

BIOTIC INTERRELATIONSHIPS
TERMINAL OBJECTIVES:

THE STUDENT WILL BE ABLE TO......

1. pick from a list those factors that are biotic and those that are abiotic
2. define population, society, community, ecosystem, biosphere
3. when given a scrambled list of the terms in #2, place them in order from simple to complex
4. use a taxonomic key to identify specimens to genus level
5. define and give examples of: autotrophs, herbivores, carnivores, omnivores, decomposers, predators, scavengers, saphropphytes, niche
6. given a food web, identify which organisms are producers, first order consumers, second order consumers and decomposers.
7. state which organisms are most numerous (in biomass) and which have the most energy in a given food web
8. predict how stated circumstances would affect each niche of a food web
9. design both an aquatic and terrestrial food web existing in quad
10. define and pick examples from a list of symbiosis, parasites, mutualites, commensalites.
11. list examples of symbiosis seen on a walk at the campus environmental studies area.
12. write a report on the life style of any parasite of his choice
13. when given a description of the life style of an organism state whether it is an example of a specific symbiosis or is free living
14. identify a description of each of the following processes: anaerobic respiration, aerobic respiration, photolysis, carbon fixation, photosynthesis.
15. trace the flow of energy through a food web from the sun to a decomposer
16. define succession, eutrophication, fertilizer, pollution, climax, pioneer organism
17. pick from a list those factors that tend to accelerate succession
18. offer hypotheses on how sewage, phosphate pollution, algae and erosion relate to eutrophication
19. recognize the raw materials and products of both photosynthesis and respiration
20. when given a diagram of one of nature's cycles eg. carbon-oxygen, water or nitrogen, with some portion left blank, pick the correct organism substance, or process that fills the blank.

21. list five ways that man has upset the above cycles

22. identify the following biomes when given a description of its altitude, latitude, rainfall, temperature or sunlight: tundra, taiga, temperate forest, tropical forest, tropical forest, grasslands, desert.

23. list factors that limit the size of a population

24. predict the population growth curve when given a set of circumstances that may or may not affect the population

25. offer a hypothesis to explain the growth curve observed in a population

26. list problems produced by the human population growth rate

27. give an opinion backed up by facts that offers a practical solution to the human population growth rate

28. define a society and give an example of an insect society and the role of each caste.

29. write a report of some type of animal behavior eg. territorialism, migration, courtship, social instincts, communication, learning, biological clocks, or others and give a 3 minute talk.

ECOLOGY INTRODUCTION

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Eco (house)...logy (study of): study of living communities and their physical environment.

Biotic: living factors; interactions of all living things, plants, animals, and protists.

Abiotic: non-living factors; physical things that affect the quality and quantity of life.

1. List 5 biotic factors existing in a wooded area in New York state.
2. List 5 abiotic factors affecting life in a stream such as Butternut Creek.

LEVELS OF ORGANIZATION

POPULATIONS	study of one species in a definite area	eg. man, ameba, maple
SOCIETY	study of a highly organized species working together	eg. baboon, bees
COMMUNITIES	study of all the living species in an area and their interactions	eg. all species in Oneida Lake
ECOCYSTEMS	the interactions of all living things with their physical environment (biotia & abiota)	
BIOSPHERE	the entire world, all ecosystems collectivaly	

IDENTIFY THE LEVEL FOR EACH OF THE FOLLOWING

3. All of the people in the world.
4. The northern pike in the St. Lawrence River and the mercury in their tissues.
5. All of the bees in a hive.
6. All organisms (plants, fish, crabs, etc.) in Butternut Creek.
7. The rainbow trout in Fourth Lake.
8. All of the red clover on the ESM football field.

9. Cyotes of Wyoming and tape worms in them.

10. A desert, its plants and animals, and climate.

11. The fish, oxygen and pollutants in Onondaga Lake.

12. The plants and animals existing together in the same woods.

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ECOLOGY
QUADRAT STUDIES

INTRODUCTION: An ECOSYSTEM is all the living things (biotic) and physical factors (abiotic0 within a definate boundary and the interrelationships that exist among them, both competitive and cooperative. We will spend the next several weeks studying all the producets, consumers, aquatic life, soil life and physical factors that interact in the plot you choose to study.

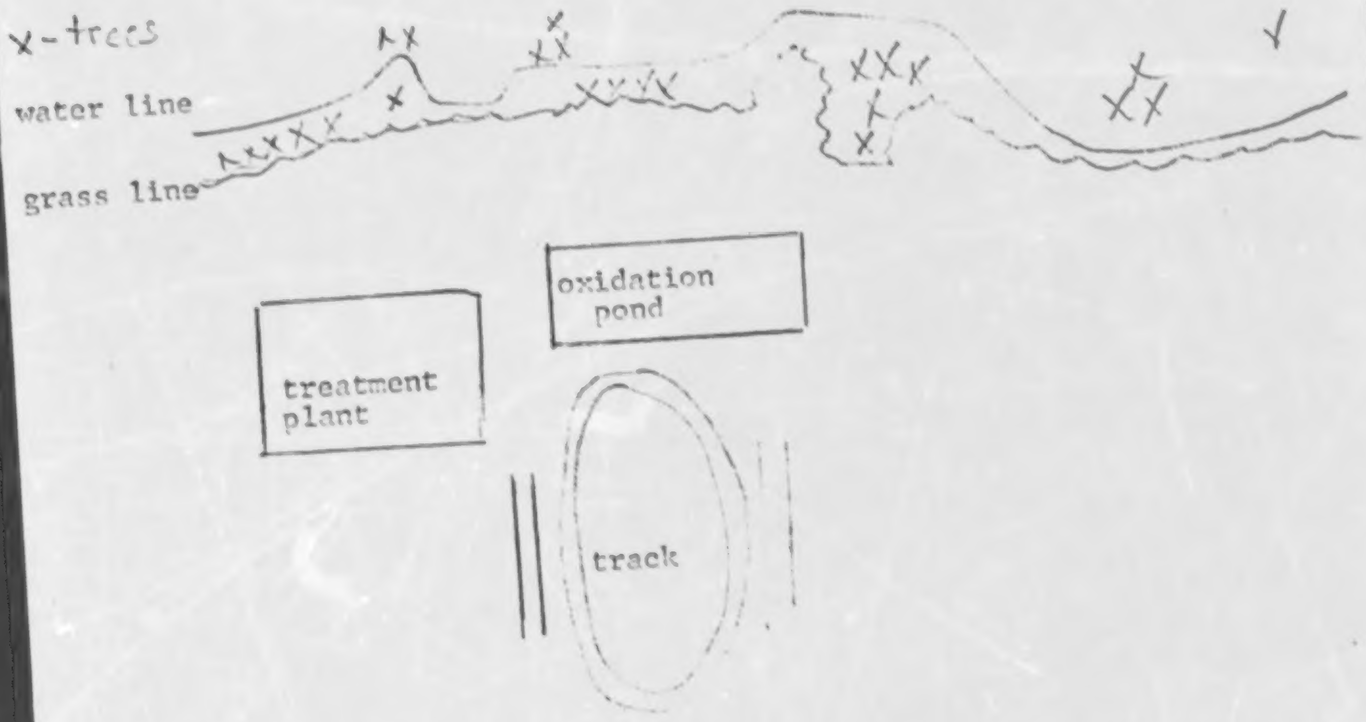
I SELECTION:

Select a plot of land on the edge of a stream such that both aquatic and terrestrial biotia are included. Measure 10 meters, place a stake at either end, tie twine to the stakes, and using right angles enclose the complete square.

Draw on graph paper a scaled map of the quadrat and note identifying characteristics (trees, holes, bumps, logs, rocks, waterline, etc).

Include a photograph of the plot or interesting parts of it.

Locate your quad on this map.



SCHOOL

II. PLANT IDENTIFICATION:

A. Take a sample of one of each type of plant in the quad. Press it, mount it, and identify its phylum, class, order, family and if possible genus and species. Taxonomic keys are available in the room.

Sample plant mounts

common name

phylum
class
order
family
Genus species

location collected
collector
date

B. Using random sampling techniques, determine the dominant populations of flora (plants). Calculate the density of abundant species:

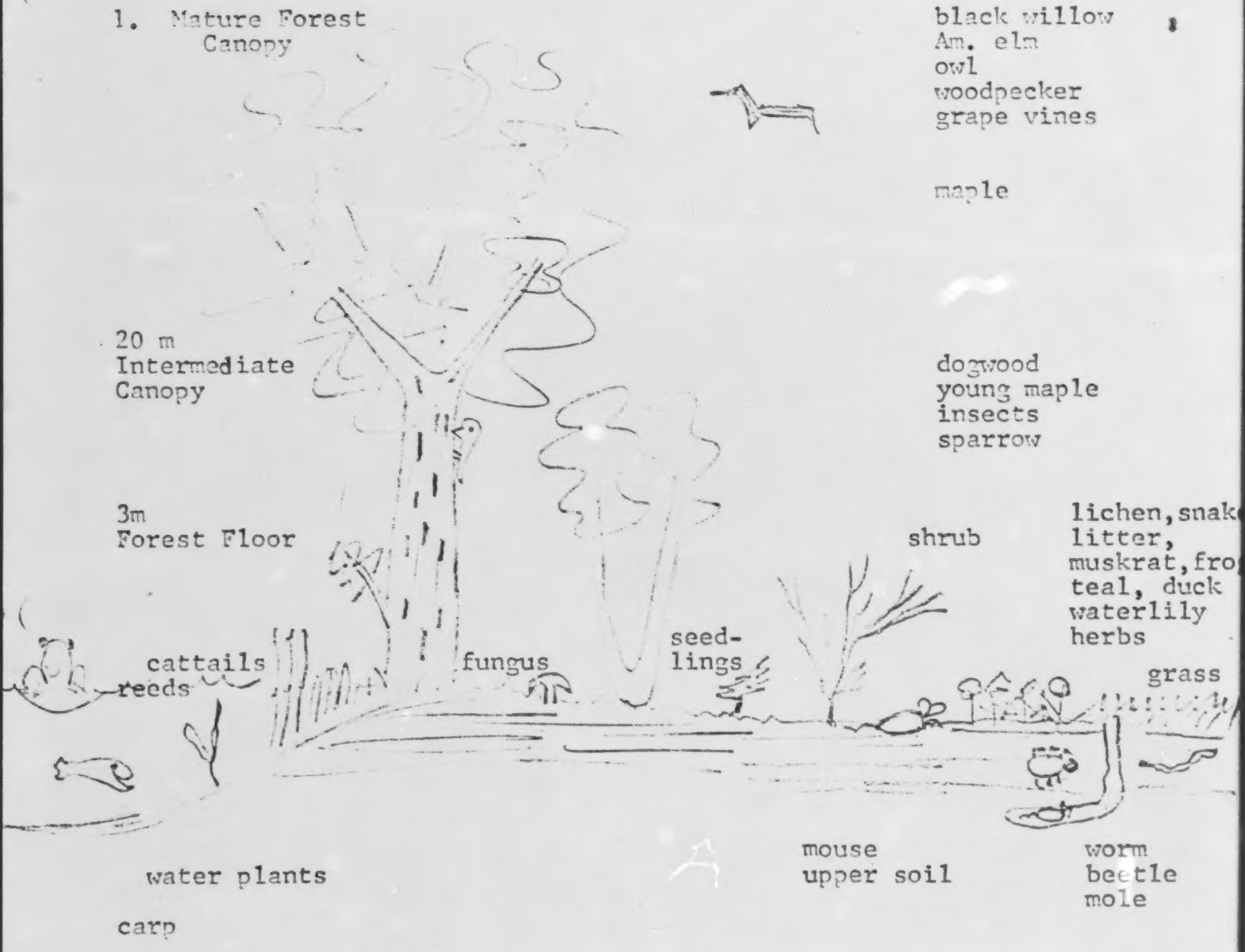
1. TREES-canopy or ceiling layer, receives direct sunlight
2. SHRUBS AND SAPLINGS-low woody plants between .5-3.0 m tall
3. HERBACEOUS- non-woody plants, weeds and grasses, die to ground level in winter, also seedlings with less than 1 cm diameter
4. FLOOR COVERING- litter, detritis of fallen leaves, mushrooms, mosses and lichens.

number trees per $100m^2$	number shrubs per $1m^2$	number herbs $1m^2$	number litter per $1m^2$

*indicates dominant species

III. LAYERING

I. In wooded areas one can observe distinct zones or layers of plants that support different types of animals. Note diagram below:


1. Mature Forest Canopy
black willow
Am. elm
owl
woodpecker
grape vines
maple
20 m
Intermediate Canopy
dogwood
young maple
insects
sparrow
3m
Forest Floor
shrub
lichen,snak
litter,
muskrat,fro
teal, duck
waterlily
herbs
cattails
reeds
fungus
seed-lings
grass
water plants
carp
mouse
upper soil
worm
beetle
mole

The forest develops from litter on forest floor to grasses and herbs. Eventually shrubs and small trees develop and finally in time the large trees of the canopy. This gradual aging of a forest is called succession.

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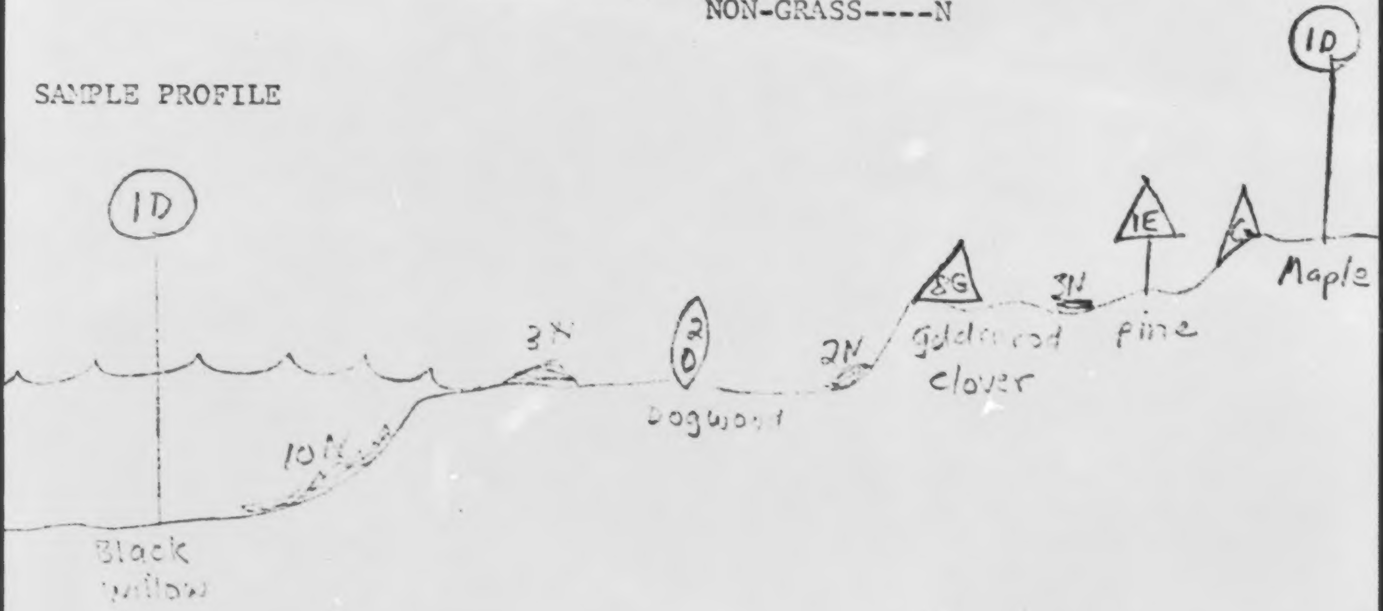
Using the symbols below, draw a profile of the quad from highland to the water's edge.

LAYERS:
○ CANOPY- trees over 20m
⇧ SUBCANOPY- trees under 20m
0 SHRUBS- 1-3m
△ HERBS-
— LITTER

TYPES:
WOODY: DECIDUOUS---------D
EVERGREEN---------E

HERBACEOUS: GRASS--------G
NON-GRASS----N

SAMPLE PROFILE


1D
10N
Black willow
3N
2D
Dogwood
2N
8G
Goldenrod clover
3N
1E
Pine
G
1D
Maple

YOUR PROFILE

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IV. SOIL ANALYSIS OR "A VERY DIRTY LAB"

In this investigation you will study some of the organisms that live in the first 6" of soil and in the litter that covers soil.

MATERIALS:
trowel & plastic collecting bags
stand
150 watt bulb & socket
2 funnels
mesh or screen
2 mayonaise jars
alcohol
cheese cloth
rubber tubing, 3"
punch clamp
dropper
microscope
microscope slide & cover slip
petrie dish
agar
pressure cooker
incubator, 37°C.

Reference books
To teacher - prepare sterile petrie dishes with nutrient agar (23g/1000ml water)

Sample some litter (leaves and branches) that cover the ground. Place this material in a funnel with wire mesh as shown in diagram. Leave it exposed to light for 2 days.

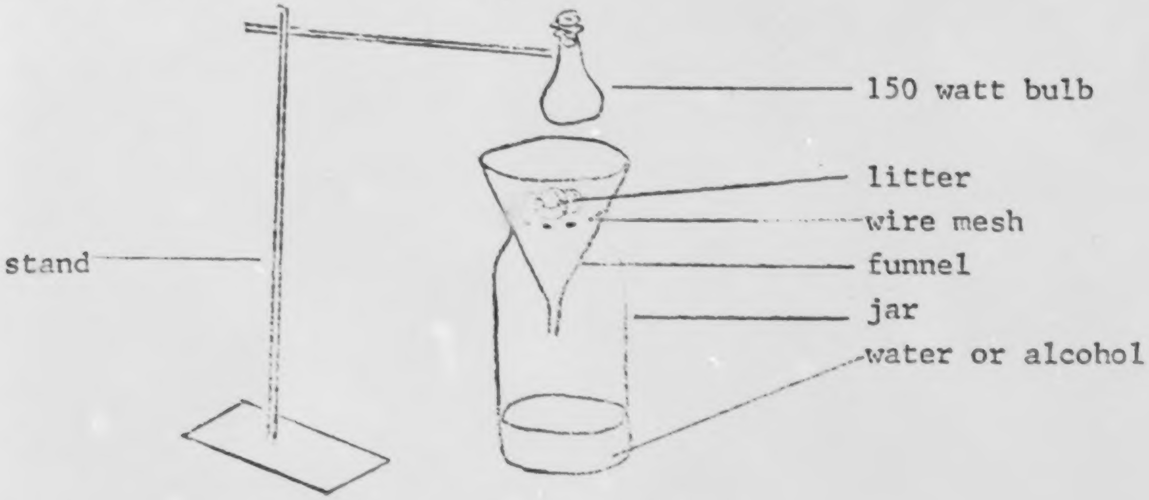

FIGURE A: BERLESE FUNNEL

SOIL ANALYSIS

Observe organisms found in alcohol and draw below: You may wish to use a 10x hand lens.

Using a reference book*, determine the names of these organisms.

B. Using a trowel, sample some soil and place it in a cheese cloth bag and funnel as shown in Diagram B. Close the clamp and pour 150ml of lukewarm water over the soil. After 2 days, open the clamp, make a microscope slide and observe. Name the organism*. Also place several drops of this soil water on agar in a petrie dish. Incubate and observe daily.

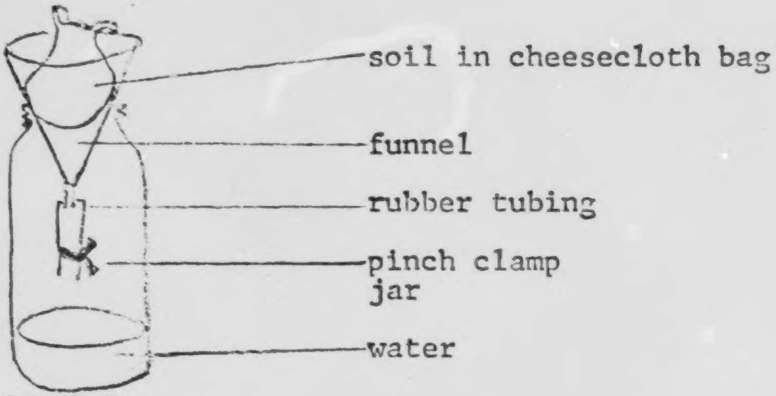
soil in cheesecloth bag
funnel
rubber tubing
pinch clamp
jar
water

FIGURE B

*Guides to Insects and Other Invertebrates
Needham, A Guide to Study of Fresh-Water Biology

OPTIONAL ACTIVITY:

1. Obtain algae samples with a plankton net, observe under microscope, identify, estimate relative density (number per square unit) and draw them.

2. Compare plants that flower in the fall and spring.

SOIL ANALYSIS

Drawing of soil microbes and bacteria

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C. DISCUSSION QUESTIONS

1) Name the organisms found in the litter? To what classification groups do they belong?

2) Name the organisms and classification groups of organisms found in 1st. 6" of soil. How do they compare to the litter sample?

3) In what other layers of a community would you expect to find:

worms-

insects-

bacteria-

spiders-

fungus-

mold-

algae-

OPTIONAL ACTIVITY

Culture bacteria on agar plate and expose it to different environmental conditions (eg. pH, light, moisture, temperature). Photograph with poloroid. Relate to land and water pollution.

V. INVERTEBRATES

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A. Insects- collect in nets and preserve in bottles. Identify using taxonomic keys the phylum, class, order and if possible genus and species. Look everywhere, leave no stone unturned!

B. Worms and Other Invertebrates- examine logs, soil, and water. Identify. Remember insect larvae resemble worms.

A. insects CLASS: INSECTA PHYLUM: ARTHROPODA

ORDER	FAMILY	GENUS	SPECIES	COMMON NAME

B. worms and invertebrates

PHYLUM	CLASS	ORDER	FAMILY	GENUS	SPECIES	COMMON NAME

POSSIBLE PROJECTS

1. Culture insects in a terrarium, ant form, etc. Observe behavior or expose to varying environmental conditions (eg. temperature, light, soil type).
2. Observe the effects of temperature on metamorphosis and relate to environment alterations by pollution.

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V. "THE GOLDENROD FOREST"

OBJECTIVES: to study the ecology of a small plot of goldenrod
to identify several species of insects (and other Arthropod inhabitants).
to investigate the role played by these creatures in respect to predator-prey relationships.

EQUIPMENT: 30 baby food jars
several books about insects
pencil and note papers (for each student)
a few small insect nets

Before we start this lab we should first know something about goldenrod. There are several species of goldenrod; there are about 5 different species which can be found in East Syracuse. However, the kind which is most common, and probably the one we'll be searching through is Canada Goldenrod (Solidago canadensis).

Description: Height to 5 ft. Stem erect, slender, smooth or downey above, somewhat angled or ridged. Leaves definitely 3-nerved, with branching veins, to 5 in. long and ½ in. wide, with shallow saw-toothed margins, narrowed at either end. Flowers borne in small heads, erect on arching to horizontal upper branches, yellow-golden in color.

You've probably heard of goldenrod before; it is quite well known because of its reputation for causing hay fever. It is intereesting to note that recent investigations have indicated that ragweed (a different plant that often lives near goldenrod) is really responsible for much of the hay fever which is blamed on goldenrod.

PROCEDURE: Each student should carry one or two baby food jars and search for insects (ONLY collect creatures found on goldenrod); put only one insect in each jar.

When you have located an insect on goldenrod observe it for several minutes before trying to capture it. While you are watching it take notes on what it is doing. (is it eating, if so, what?; where on the plant is it located; is it moving around; does it blend in well with its surroundings; etc.) Answer questions on page 2.

Use caution in capturing your creature. Some of them may be hard to catch and some of them, such as bees and wasps, may inflict painful stings or bites.

Return jar with insect (or whatever beast you've captured)to the area where the books are. Use the books available to identify your captive. If you need help don't be afraid to ask for help; some insects are difficult to identify. When you have identified the insect find as many facts as you can about it. (YOU WILL BE ASKED TO TELL THE CLASS ABOUT YOUR CREATURE).

After about 40 min. of capturing and reading the class will meet and each student will give a 2 to 5 minute talk about the creature he or she collected. Use page 2 as an outline for your talk.

NOTES ON YOUR CREATURE:

Class----------------------Order---------------------Genus species

____

COMMON NAME ____________________________

What was it doing on the goldenrod?

What does it eat?

How does it obtain its food?

Is it a predator or prey?

Does it live only on goldenrod?

What is its range and origin?

How does it move?

Discuss its life cycle?

Draw a good, detailed, large picture of your creature below.

VI. VERTEBRATES- set traps and lines and look for any traces (footprints, droppings, nests, burrows, of birds, small mammals, amphibians, reptiles, and fish.

PHYLUM: CHORDATA

CLASS	ORDER	FAMILY	GENUS	SPECIES	COMMON NAME	EVIDENCE (tracks, etc

*indicates dominant species

PROJECT SUGGESTIONS:

Survey fish species of different areas of creek. Establish mouse or mole territories by marking captured specimens and releasing them.

NAME ____________________

VII. FOOD WEBS: READ FRESH WATER ECOLOGY pp.2-13.

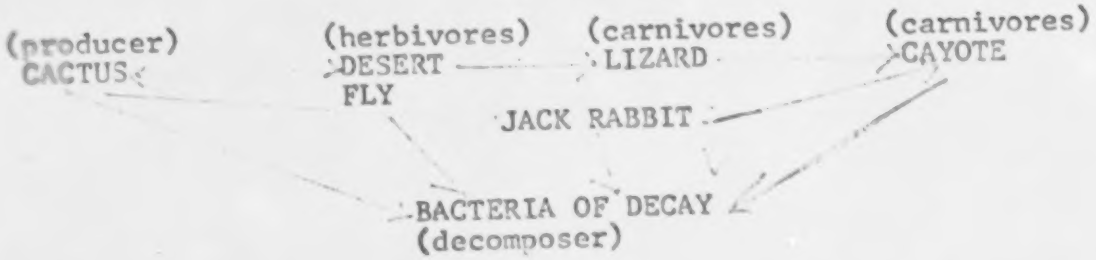
Define the role of each of the following to a community:

1. producer
2. herbivore
3. carnivore
4. omnivore
5. decomposer

6. Why is there more mass of producers than any other level?

7. Why do decomposers have the least amount of the original energy from the sun?

8. Diagram a food web exsisting in your quad.
Ex.:


(producer)
CACTUS
(herbivores)
DESERT FLY
JACK RABBIT
(carnivores)
LIZARD
(carnivores)
CAYOTE
BACTERIA OF DECAY
(decomposer)

OPTIONAL ACTIVITY:

Photograph microbes and make a picture food web.

9. What is the role of each of the following organisms in the litter and soil layer (producer, herbivore, carnivore, omnivore, and decomposer)?

bacteria-

fungus-

algae-

dead leaf-

lichen-

earthworm-

maggot-

beetle-

spider-

daddy longlegs-

mold-

microcrustaceans-

centipede-

fly-

mosquito-

NAME________________________

VIII. AQUATIC FOOD WEBS:

Take a sample of plankton and water near the shore in your quad. Observe it under the microscope. Draw and identify as many microbes as possible (protozoa, algae, crustaceans, etc.)

DRAWINGS: label and give magnification

DIAGRAM A FOOD WEB existing in the creek.

NAME ____________________

ECOLOGY QUIZ

AQUATIC FOOD WEB

1. Design a food web that might exist in or around a fresh water pond. Identify several organisms at each level (niche): producer, first order consumer, second order consumer, third order consumer, etc., and decomposers.

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2. Refer to your food web to answer these questions.
   A. Which organism would be present in the greatest numbers?
   B. Which organism would have most of the original sun's energy?
   C. Which organism do all the others depend upon?
   D. How would a population of a carnivore affect each other niche?
   E. How would a disease of an herbivore affect each other niche?
   F. How would water pollution by raw sewage affect each organism in the food web?
   G. Phosphate pollution by fertilizers, detergents and industry stimulate algae growth. How would phosphate pollution affect each niche in your food web?

3. In which niche does each of the following belong?

tapeworm
fox
seaweed
fern
frog
trout
earthworm

snail
grasshopper
mushroom

bacteria
cow
goldenrod
maple
carp
hydra
daphnia

FILM STRIP "SYMBIOSIS" NAME____________

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1. Define symbiosis in its broadest sense.

2. What relationship exists between the honey guide bird and the ratel?

3. Some relationships of mutual benefit (MUTUALISM) exist between an animal and a plant. Explain the relationship between:

   three toed sloth and algae

   English blue butterfly, thyme bush and ants

   sphinx moth and honeysuckle

4. Sometimes one benefits while the other partner is not affected one way or the other (COMMENSALISM). How do the following illustrate this?

   Man of War and certain fish

   luminous squid

   trumpet fich and parrot fish

   rufous woodpecker and black tree ants

5. Define parasitism and give three examples.

6. Matching:

   osprey and wrens
   crab and anemone
   insect and flower
   grouper and teeth cleaner
   long horned beetle and scorpion
   ostrich and zebra
   tapeworm and dog
   shark and remora fish
   crocidile and bird
   lichen
   termite protozoan
   malaria germ and man
   nitrogen fixing bacteria and legune
   whale and barnacle

   P - parasite
   C - commensalite
   M - mutualite

7. Now take a walk through the environmental study area on campus. List all the evidences of symbiots you observe. Elect one member of your class to use the science department Polaroid camera to record these evidences on film.

ECOLOGY LAB

NAME BEST COPY AVAILABLE

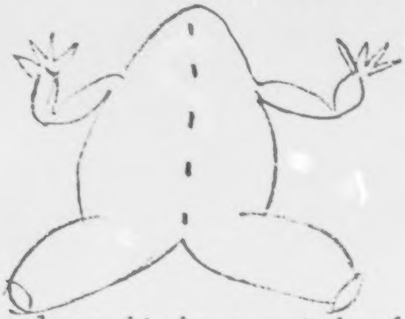
IDENTIFYING LIVE PARASITES

Parasites live off their hosts at the host's expense drawing nourishment and protection. In this investigation you will catch a live frog, toad, fish, bird or mouse. Dissect it and observe its parasites with the microscope. A frog is preferred since as an amphibian it is host to both aquatic and terrestrial parasites.

PROCEDURE:

1. Pith the frog and chloroform the other specimens. A frog is pithed by inserting a needle into the base of the skull where the spinal chord connects to the brain. There is a depression here. Move the needle from side to side to sever nerves.

2. With scissors, cut your specimen on the belly side (ventral) from mouth to anus and reveal inner organs (viscera).



As you remove tissue, place it in a petrie dish covered with Ringer's (saline) solution. This solution has the same concentration as body fluids.

3. Examine skin and muscles for flukes. These are platyhelminthes (flat worms related to planaria). Some flukes may be in cysts, little pockets of tissue.

4. When you have located a muscular fluke, make a wet mount slide. It is probably Clinostomum. Label the 2 branches of its intestine on your drawing. This fluke is found in frogs, frog eating birds, bass, and turtles.

5. Insert scissors into trachea (windpipe) and open air sacs of lung. The fluke, Haematoloechus, often lives in the upper areas. Mount this fluke and draw it. Label the black substance in the digestive tract. What is it? In the fluke's uterus you may see 1000's of eggs and developing flukes. Hatched flukes move up the windpipe, are swallowed, pass along the digestive system and exit via the anus.

6. Also in lung tissue lives a nematode (roundworm), Rhabdolias may see an egg carrying female. All stages of development can be observed. Draw these.

7. Within the urinary bladder you may find Gorgodera or Gorgoderina. Remove the bladder and place it in Ringer's Solution. Draw these worms and label the suckers at both ends.

8. Examine the stomach contents and look for Loxogones. Most parasites are located in the digestive tract.

9. Remove the small intestine and slit it open. Place it in Ringer's solution. Observe what your specimen has recently eaten. Check the intestinal walls for parasites such as the fluke, Cephalogonimus, nematodes and the tapeworm, Ophistaenia. Mount the tapeworm on a slide, draw and label its segments.

10. Place the rectum in Ringer's solution and slit it open. You may see the flagellate, Trichomondas, (it has an undulating membrane), or the cillate, Opalina (with no mouth) or Nictotherus (definite mouth) or the fluke, Diplidisis (large sucker at one end). Draw and label these.

11. Also you might observe the following:

    skin---red mites, leeches
    fur, feathers---fleas, ticks

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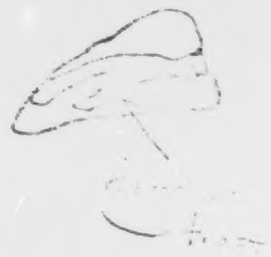
NAME OF SPECIMEN (HOST)

DATA:

LOCATION OF PARASITE	CLASS & NAME	NUMBER OBSERVED	DRAWING (label & give magnification)
SKIN	PLATYHELMENTHES (fluke) CLINOSTOMUM		 10x
MUSCLES			
LUNG			
BLADDER			

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LOCATION	CLASS & NAME	NUMBER	DRAWING
STOMACH			
SMALL INTESTINE			
RECTUM			
FUR OR FEATHERS			

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DISCUSSION:

(1) Match the parasite with its class

___ liverfluke

___ lung roundworm

___ tapeworm

___ flagellate

___ cilliate

A. Platyhelmenthes

B. Nemotoda

C. Protozoa

(2) Why are most parasites found in the digestive tract?

(3) What is the purpose of the sucker on the parasite?

(4) Why do parasites have well-developed reproductive systems and simple digestive systems?

(5) Using a book from the library and write a description of the life style of a parasite. Include: all stages of its life cycle (egg through adult)

the host organisms for each stage

any symptoms or disease produced in the host

(6) List all references.

POSSIBLE PROJECTS:

1) Repeat this experiment with specimens from various places.

2) Photograph all life cycle stages of several parasites and compare them.

POINT DISTRIBUTION:

DATA	25 points
QUESTIONS 1-4	40 (10 each)
REPORT ON PARASITE	30
REFERENCES	5

Optional Lab:

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"A LOT OF GALL"

SYMBIOTIC RELATIONSHIPS BETWEEN INSECTS AND PLANTS

Insect galls are formed when the insect lays its eggs inside plant tissues and a benign tumor develops. The insect egg hatches within this plant tissue, feeds off of it, and derives protection. The larval and pupal stages progress within the bunch of plant cells. Eggs are laid either in the spring or fall, and the adult emerges in the fall or early spring respectively. Adult insects, incidently, disperse pollen from flower to flower as they forage for nectar.

Is this relationship between the plant and insect that of parasitism, commensalism, or mutualism? Explain your hypothesis.

TYPES OF GALLS OBSERVED AT THE E.S.A.

I. GOLDENROD

A. BUNCH BALL: This growth looks like a dryed flower. It is caused by an aphid laying its eggs in the fall. Wingless adults emerge in the spring. The larvae from which they developed fed all winter on plant juices. By fall, wings develop, mating occurs, and another life cycle begins. This change of body form throughout development is called metamorphosis.

B. BALL GALL: A roundish, almost spherical growth develops along the stem when the peacock fly lays its eggs within the goldenrod stem. Egg laying occurs during the fall, larval development in winter, pupation and emergence of the adult in spring. The adult peacock fly is slightly larger than a house fly and brownish in color.

C. ELLIPTICAL GALL: This elliptical shaped gall is caused by the caterpiller of a small moth. Mating occurs in fall and hatching in spring.

II. PUSSY WILLOW: The pinecone gall forms on the end of a stem when an aphid lays its eggs in the pithy center of the stem. It appears scaly like a pine cone.

III. CATTAIL: This association does not result in a true gall, but is a similar type of mutualism. The cattail moth lays its eggs in the fruiting body of the cattail. By spring, the larvae have hatched. Crawling around, it loosens the seeds, they fluff out, and are dispersed.

IV. OAK: These trees are host to more galls than any other plant species.

A. OAK APPLE: This round mass is attached to a leaf and is is filled with a thick cottony mass and has a hard kernal in the center. A wasp grub is inside.

B. OAK LEAF GALL: These are small gray bumps on the upper edge of the leaf. A midge causes these.

V. PIGNUT HICKORY: Roundish bunches appear along the petioles of the leaves (in groups).

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INVESTIGATION:

Most galls can be collected in late fall, winter, or very early spring. Collect a group of galls. Dissect some, observe the larvae and sketch. Leave the larva within the partially opened gall. Place it in a jar and cover with cheese cloth or a nylon stocking. Also place some unopened galls in covered jars. Observe once a week for several months. When the adult emerges (spring) it will be captured. Also sketch and identify the adult. This lab works well with goldenrod galls.

DISCUSSION QUESTIONS:

1) Define metamorphosis.

2) Describe the differences between complete and incomplete metamorphosis.

3) List in order the stages in the development of an aphid.

4) What is an insect gall and what type of symbiosis does it represent?

5) In what way does the plant benefit from this association?

6) List some factors that could affect the rate of insect development within a gall. (Hint: Thyroxin accelerates tadpole metamorphosis and refrigeration followed by warmth shortens frog hibernation).

7) EXTRA CREDIT: Choose one of the above factors and design a controlled experiment to test the effect on insect metamorphosis.

INSECT GALLS

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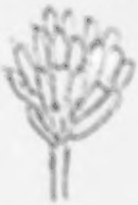
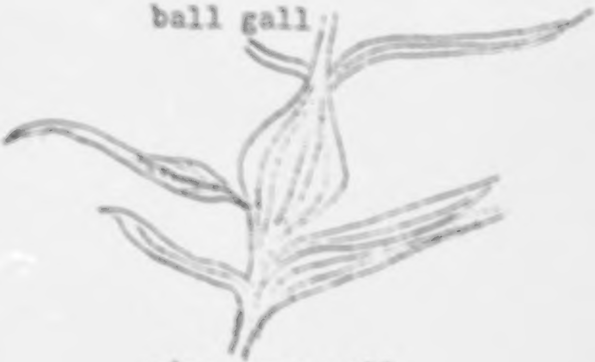
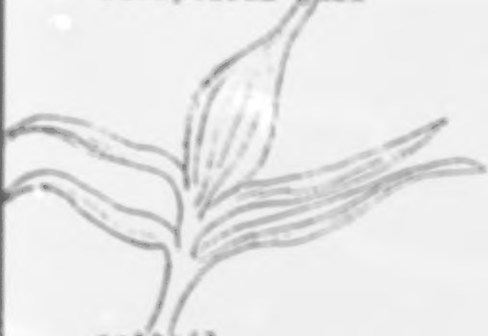
bunch gall



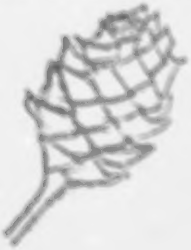
ball gall



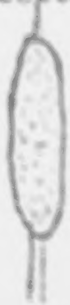
elliptical gall



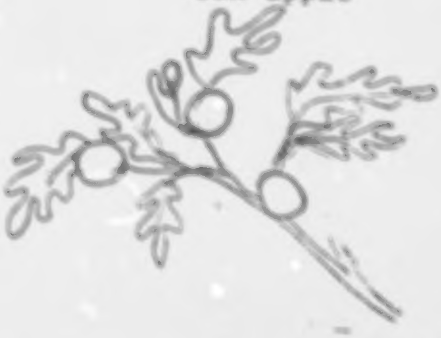
pine cone gall



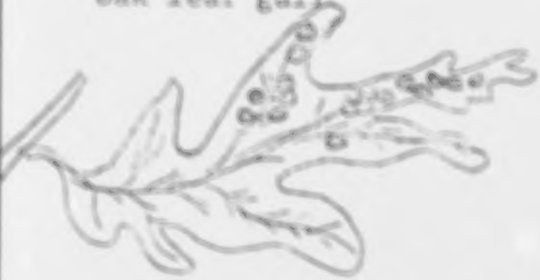
cattail



oak apple



oak leaf gall



REFERENCES:

New York State Conservation Dept. Information Leaflet, "Some Architects of the Insect World," April-May 1962.

Comstock, Handbook of Nature Study.

Palmer, L.E., Field Book of Natural History, McGraw-Hill, 1949.

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USE ANSWER SHEET

ECOLOGY TEST #1
BIOTIC INTERACTIONS IN A COMMUNITY
PART I (2½ points each)

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1-5: Match those factors which affect living things with the proper ecological category A) abiotic or B) biotic

1. predator-prey relationships

2. oxygen concentration of a stream

3. population fluctuations

4. sunlight vs. shade

5. air pollution

6. Which group of terms is arranged in correct order from simple to complex?
A) biosphere-ecosystem-organism-community-population
B) organism-population-community-ecosystem-biosphere
C) population-organism-community-ecosystem-biosphere
D) organism-population-ecosystem-commusity-biosphere

7. The living and the non-living factors that affect a stream constitute A) population, B) community, C) ecosystem, D) biosphere

8. All the members of a given species living in a given area constitute A) community, B) biome, C) ecosystem, D) population.

9. Which of the following BIOTIC factors might affect a population? A) oxygen concentration, B) predators, C) climate, D) water populatio

10. A close relationship between organisms of different species is called
A) habitat
B) symbiosis
C) predator
D) scavenger

11. An organism which is strictly a plant eater
A) herbivore
B) carnivore
C) omnivore
D) autotroph

12. Which niche is filled by fungi and bacteria?
A) producer
B) first order consumer
C) second order consumer
D) decomposer

13. A relationship which one organism depends on another to live and both are benefited is referred to as
A) parasitism
B) mutualism
C) commensalism
D) saphrophytism

14. An autotroph
A) eats plants only
B) eats meat only
C) eats both plants and meat
D) produces its own food

15. Organisms that live off others (hosts) and do harm to them such as a virus are
A) parasites
B) commensalites
C) omnivores
D) herbivores

16. The living and the non-living factors that affect a stream constitute a
A) population
B) community
C) ecosystem
D) biosphere

17. An autotroph A) eats plants only, B) eats meat only, C) eats both plants and meat, D) produces its own food.

18. A hawk hunting mice is an example of a A) society, B) predator C) parasite, D) scavenger

19. All of the following are HERBIVORES except A) cow, B) deer, C) sheep, D) wolf

20. Bacteria of decay are examples of A) decomposers, B) producers, C) herbivores, D) consumers

21. Which is an example of an organism that is classified with the Protists?
A) moss
B) sponge
C) hydra
D) paramecium

22. Host organisms are involved in the nutritional relationship known as
A) mutualism
B) succession
C) saprophytism
D) parasitism

23. The flow of energy in an ecosystem is represented by
A) seeds---sparrows---hawks---bacteria
B) sparrows---bacteria---hawks---seeds
C) hawks---seeds---bacteria---sparrows
D) sparrows---seeds---hawks---bacteria

24. Animals that ingest both plants and animals are known as
A) omnivores
B) carnivores
C) herbivores
D) saprophytes

25. Competition by two species for the same ecological niche generally results in
A) the sharing of the niche by the two species
B) one species taking possession of the niche
C) both species leaving the area
D) interbreeding between the two species

26. Any ecosystem requires a continual input of energy because
A) matter is used repeatedly in matabolic processes
B) energy is lost each time it si transferred between organisms.
C) biological succession occurs so slowly
D) local populations tend to evolve into new forms

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27. Mice, insects, grasses, shrubs, owls, and trees can be found in an area consisting of a forest and a grassland. The smallest population (in numbers) would most likely be the
A) insects
B) mice
C) grasses
D) owls

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28. The best description fo a 1st order (primary) consumer is that it
A) captures light energy to make food
B) utilizes carbohydrates which it ingest.
C) is generally a food source for producers
D) changes inorganic compounds to carbohydrates

29. Practically all species of organisms may be consumed by more than one other species. This situation is known as
A) a food web
B) symbiosis
C) an autotrophic response
D) a heterotrophic response

30. In which relationship is one organism benefited while the other is not affected positively or negatively?
A) lichen (algae and fungus)
B) athlete's foot fungus and man
C) remora fish and shark
D) termite and protozoa

31. Within any ecosystem the total number of 2nd order (secondary) consumers must be
A) less than the total number of herbivores
B) greater than the total number of herbivores
C) equal to the total number of producers
D) consistently the same number year after year

32. Which are 1st order (primary) consumers?
A) spiders
B) cows
C) algae
D) hemlock seedlings

33. In which group is an organism least likely to be limited in the sources of food on which it depends?
A) carnivores
B) omnivores
C) herbivores
D) saprophytes

34. Introduced species of plants and animals often become pests in their new homes, although they were not pests in their native habitats. The most important reason for this is that they
A) may reproduce in large numbers
B) can resist adverse climatic conditions
C) are free from natural enemies
D) may adapt to new food supplies

35. If there were a long and widespread drought in a biotic community composed of grasses, antelopes, and lions, the most immediate effect would be
A) a decrease in the lion population
B) an increase in the amount of grass present
C) an increase in the antelope population
D) a decrease in the antelope population

PART II: CHOOSE A OR B (12 points)

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A. Design either an aquatic food web or soil food web that might exist in your quad.

Identify each of the following in your food web. Give specific names (common names).

1. producer
2. 1st order consumer
3. 2nd order consumer
4. symbiotic relationship (specify)
5. decomposer

B. Using a taxonomic key available from your instructor, identify 5 specimens by common name. Refer to the specimens by the letter that labels them. Partial credit will be given for any other levels of investigation ex. telling if a plant is a monocot or dicot, if a plant is in the rose family or composite family, etc., telling if a bug is in the class insect, arachnid or annelid, etc., or giving its order (hymenoptera or lepidoptera, etc.)

ECOLOGY LAB: NAME BEST COPY AVAILABLE

AQUATIC ENVIRONMENTS AND DISSOLVED OXYGEN

BACKGROUND ON PHOTOSYNTHESIS---You will recall from biology that photosynthesis is the only process to naturally produce oxygen. Photosynthesis can be broken down into two major phases as summarized below:

Light Phase (Photolysis)

$$H_2O \xrightarrow{\text{light + enzymes}} H^+ + O2$$

Dark Phase (Carbon Fixation)

$$CO_2 + H^+ \longrightarrow C_6H_{12}O_6 + H_2O$$

Life on land and in water depend on the amount of oxygen available. In aquatic environments the oxygen is dissolved in the water (D.O.).

PURPOSE: We will test whether an aquatic green plant is necessary for oxygen to be present in water.

PROCEDURE: Day One:

1) Take 5 D.O. bottles and fill them with boiled water (nearly full).

2) Place 20ml of brom blue in a beaker and carbonate it by adding just enough soda water to change its color to yellow (or blow through a straw to effect a color change). Brom blue is a carbonic acid indicator when it is yellow

3) Add enough yellow brom blue to each D.O. bottle to see some color (yellow). Be sure the bottle is overflowing.

4) Label each bottle A-E.

5) To bottles A and B add a sprig of elodea (Anachris). Chlorella may also be used effectively.

6) Insert the ground glass stoppers so as not to introduce any air bubbles. It will help if it is lubricated with vaseline.

7) Cover bottles A and C with aluminum foil so that they are light tight.

8) Place bottles A,B,C, and D near a light source for 24 hours.

9) Perform a D.O. test on bottle E and record in data table.

10) PREDICTION---Which bottle(s) do you predict will contain the most D.O. tomorrow?

11) DAY 2: Perform D.O. tests on bottles A,B,C, and D and record in data table below:

DATA:

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BOTTLE	A	B	C	D	E
CONTENTS					
TREATMENT					
COLOR BEFORE					
COLOR 24 HRS. LATER					
D.O. (ppm)					
CONCLUSION:					

INTERPRETATION:

1) Why was CO_2 added to the solution?

2) What was the purpose of brom blue? Could this experiment be performed without brom blue?

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3) Which bottles can be considered controls?

4) In which bottle(s) was the most oxygen produced?

5) What process removes O_2 and produces CO_2 to keep the cycle going?

6) List all the materials and conditions necessary for oxygen production.

7) How many p.p.m. of D.O. are required by most aquatic organisms?

8) Explain how the D.O. of a stream might be affected by a rainstorm that makes the water turbid (muddy).

9) In summer some swamps and ponds become green with algae growth; how would this affect the amount of oxygen in the water? (consider light penetration). What might stimulate this overgrowth of algae?

10) List some other conditions that might reduce photosynthesis or algae growth or in some way lower the D.O. of an aquatic ecosystem?

11) List all references by author, title, and page.

POINT DISTRIBUTION:

PREDICTION................	5
DATA......................	10
CONCLUSIONS...............	10
QUESTIONS 1-10............	7 each
REFERENCES................	5

FURTHER INVESTIGATIONS:

1) Color of light (wave length) and amount of D.O.

2) Various types of aquatic plants and rate of oxygen production.

3) Light intensity and rate of photosynthesis.

4) Stream depth and D.O.

5) Turbidity and D.O.

6) Stream velocity and D.O.

7) Phosphate pollution and D.O.

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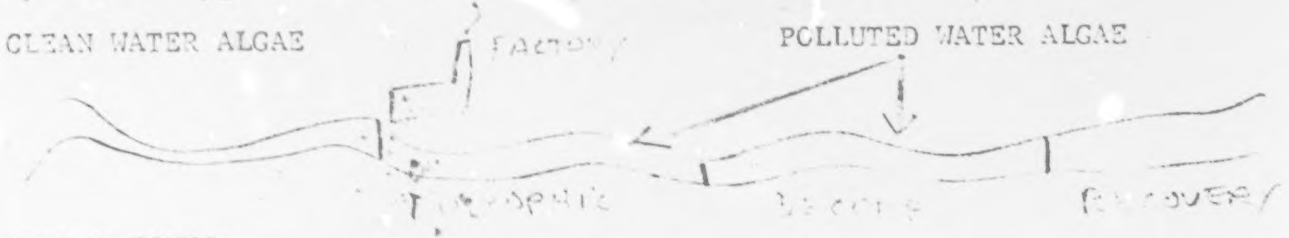
ECOLOGY LAB: INDEX ALGAE

BACKGROUND: Algae are plant-like protists. Most contain chlorophyl and are responsible for production of carbohydrates and oxygen by the process of photosynthesis. Most are unicellular an microscopic, such as pond scum, however some filamentous forms, such as giant kelp, may grow to be a hundred feet long. Algae usually is aquatic or marine but some species grow on tree bark or in soil or on insects or in association with fungi (lichens).

All living organisms depend on algae to produce carbohydrates (food) and O_2. About 90% of photosynthesis occurs in aquatic environments.

Algal blooms or overgrowths can be stimulated by chemical pollutants, eg. phosphates, and organic pollutants, eg. sewage, that fertilize and nourish them. An over-growth depletes the oxygen and forms a blockage layer, preventing light penetration. As a result, fish, crabs, etc., die and accumulate on the bottom. Excess decay follows. This results in an eutrophic condition.

Zones of a stream in various degrees of purity can be identified by their oxygen content and specific algal species present.



STREAM ZONES:

CLEAN WATER ZONE: occurs before affluents enter

EUTROPHIC ZONE: follow affluents containing sewage, chemicals, organic nutrients, soil, fertilizers

DECOMPOSITION ZONE: bacteria oxidize and degrade organic nutrients

RECOVERY ZONE: naturally purified water, it's clean! Some streams are so polluted that the decomposition zone continues in to the ocean and there is no recovery zone.

PROCEDURE:

1. Collect water from 3 different zones of a stream. Use 1 quart wide-mouthed jars (mayonaise). Add scrapings from rocks, leaves, and twigs in the water.

2. Collect another sample from each zone using a stoppered D.O. bottle.

3. Determine the pH, temperature, and nature of water flow in the 3 zones.

   *NOTE: Save these samples to observe succession.

4. Within 24 hours, study all samples. Determine D.O. from sample in D.O. bottle.

5: Make wet mount slides from sample in jar and draw and classify all organisms observed.

BEST COPY AVAILABLE

DATE

[illegible]

pH		
TEMPERATURE (°C)		
WATER MOVEMENTS		
D.O. (p.p.m.)		
MICROBES (DRAW AND LABEL) (GIVE MAGNIFICATION) (IDENTIFY)		

INTERPRETATION:

1. What was the source of effluent in the stream?

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2. Which zone had the greatest amount of oxygen?

3. Which zone is probably most productive?

4. What kind of water movement is associated with the clear water zone?

5. What factors might cause pH differences in the zones? What was the clear water pH?

6. What might cause the temperature to vary?

7. How would various temperatures affect algal growth?

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8. What type of algae was dominant in the clear water zone? Decomposition zone?

9. Decay organisms carry on aerobic respiration to oxidize dead organisms. Write a word equation for respiration.

10. If photosynthesis produces oxygen, why would excess algae be harmful?

POINT DISTRIBUTION:

DATA.........................10 each zone..........30 points

QUESTIONS..................... 7 each...............70 points

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ECOLOGY LAB: DO ONE OF THE FOLLOWING. RELATIVE PRODUCTIVITY

EXPERIMENT A: TERRESTRIAL COMMUNITY

PRODUCERS are the autotrophs or organisms that produce their own food. They have evolved a mechanism of absorbing light energy and synthesizing organic compounds. All other organisms in the food web depend on them.

PRODUCTIVITY refers to the total mass of organic food that an area can manufacture for a certain length of time. Fluctuations in productivity affect all other organisms in the community and can become a limiting factor.

BIOMASS is expressed as the air-dry weight per unit surface area of a habitat. It may also be expressed as the volume or weight per unit volume of habitat. Slight error is encountered due to non-nutritive items such as skeletons. Biomass of plants give a measure of potential productivity.

RELATIVE AMOUNT OF CHLOROPHYL also gives an estimate or relative productivity and can be used to compare two communities. Chlorophyl can be extracted and its volume or dry weight can be measured per unit area or volume.

PROCEDURE: In this lab, we will compare the amount of chlorophyl in several habitats to determine relative productivity.

1. Obtain specimens of decidious leaves, coniferous needles, aquatic plants, weeds and grasses. Cut the leaf specimens into small pieces and separate twigs. Grind them with sand and dry in an oven. Weigh out uniform quantities of each, 1g.

2. Place each sample in a large test tube with uniform amounts (30ml) of alcohol. Heat in a hot, not boiling, water bath until the chlorophyl has been extracted. Pigment could also be extracted with 90% acetone. Allow solution to clarify.

3. With a colorimeter, measure and record the relative amounts of light transmission. There is an inverse relationship between the amounts of light transmission and the amount of chlorophyl (potential productivity). Use filter #5543 and the scale for transmittance. First standardize with plain alcohol, (or acetone) then use an equal quantity of extract.

4. Record your results and write a conclusion as to which type of autotroph has the maximum potential productivity per unit weight. Relate this to the relative productivity of different habitats and to the type of consumers there.

1. DATA TABLE A: 1g. leaf, alcohol solvent, colorimeter scale: color, filter #5543.

TYPE LEAF	% LIGHT TRANSMITTANCE	RELATIVE AMOUNT OF CHLOROPHYL
CONTROL - SOLVENT		

2. Which type of leaf is most productive gram for gram? How can you tell?

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ECOLOGY LAB: RELATIVE PRODUCTIVITY

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EXPERIMENT B: AQUATIC COMMUNITY

PROCEDURE:

1. Using D.O. bottles take 2 plankton samples from: a fast moving stream, slow moving stream, a pone, and a swamp.

2. Cover one bottle from each site with foil and leave the other uncovered. Place in light for 6 hours at 20°C. You may have to take samples before homeroom.

3. Six hours later (if set up at 9:00 a.m. then check at 3:00) run a D.O. test using double reagents. Record in data table.

4. The following formula will help you calculate the relative productivity (Pr) for each of the water sites sampled.

$Pr=0.375 ((O_L - O_D) +1/t)$ in MgC fixed/l/hr.

where Pr=relative productivity

O_L=D.O. in light bottle

O_D=D.O. in dark bottle

t=time of incubation (6 hrs.)

NOTE: A similar procedure may be used with seaweeds if sprigs of equal length are used and the dry weight of the plant calculated.

DATA B: EQUAL PLANKTON SAMPLES IN DARK & LIGHT BOTTLES OVER 6 HR. PERIOD

SAMPLE SITE	D.O. DIFFERENCE $O_L - O_D$	RELATIVE PRODUCTIVITY (Pr)

2. Which water site was most productive? How can you tell?
3-12 same questions for parts A and B.

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POINT DISTRIBUTION:

DATA............................20 pts.

QUESTION #2....................20 pts.

QUESTIONS 3-12................. 6 each = 60

POSSIBLE PROJECTS:

1. Explore the relative productivity of a stream over 2 or 3 seasons.
2. Compare the relative productivity of a pond at various depths and correlate to light penetration.
3. Classify algae in various sections of a stream and identify index algae.

1. What are the two raw materials used in photosynthesis?

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2. What is the energy source for photosynthesis?

3. What important pigment is involved? How does it function to start photosynthesis?

4. What are the two end products of photosynthesis?

5. Which end product is most important to the plant and why is it important?

6. Describe the steps in PHOTOLYSIS and write an equation.

7. Describe the steps in CARBON FIXATION and write an equation.

8. What things are carried over from photolysis to the dark phase?

9. Explain two reasons why you should "thank a green plant today."

10. Trace the sun's energy from the sun through autotrophs to decomposers.

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ECOLOGY LAB NAME ______________________

SUCCESSION ON A SLIDE

As an ecosystem ages, the dominant species change relative to changes in the physical environment. This natural aging is succession. One dominate species succeeds (follows) another. As discussed earlier, the addition of organic nutrients in great quantities (pollution) accelerates this process. Eutrophication is speeded up succession.

Read the B.S.C.S. Yellow Version pp. 218-221 and 701-703.

PROCEDURE:

1. Place a microscope slide in clear water stream sample from the index algae lab.
2. Observe the slide once a week for a month.
3. Draw and identify the dominant species each week.

DATA

WEEK 1	WEEK 2	WEEK 3	WEEK 4

DISCUSSION:

1. How did the dominant species change?

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2. After 1 month, the index species would indicate water from which zone?

3. During which week would you expect to find the lowest D.O.? Explain.

4. What changes in the physical environment of a stream would accelerate succession?

5. Complete this chart:

	DEFINITION	AQUATIC EXAMPLE	TERRESTRIAL EXAMPLE
SSION			
ER ES			
Y ES			

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POINT DISTRIBUTION:

DATA........................35

QUESTIONS 1-4................20 (5 each)

CHART........................45 (5 each)

ECOLOGY NOTES ON CYCLES

NAME ______________________________

The major atoms important to living things are C, H, O, and N. These are found in a variety of molecules and are constantly recycled by nature. Refer to the Yellow Text pp. 686-697.

WATER CYCLE: sketch the water cycle and tell the role of each of the following to recycling H_2O.

evaporation
precipitation
transpiration
respiration

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NITROGEN CYCLE: sketch the nitrogen cycle and tell the role of each of the following to recycling nitrogen.

nitrogen fixation
protein synthesis
decay
nitrification
dentrification

CARBON-OXYGEN-CYCLE: sketch the carbon oxygen cycle and describe the importance of:

photosynthesis
respiration

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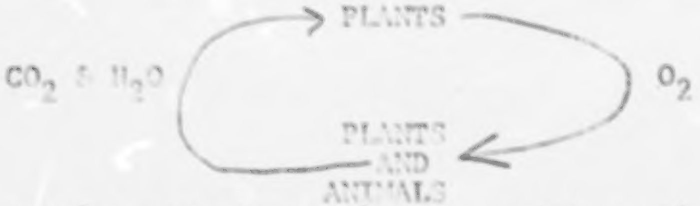
ECOLOGY TEST #2 BEST COPY AVAILABLE USE ANSWER SHEET
PART I (2 pts. each)

ABIOTIC INTERACTIONS IN ECOSYSTEMS



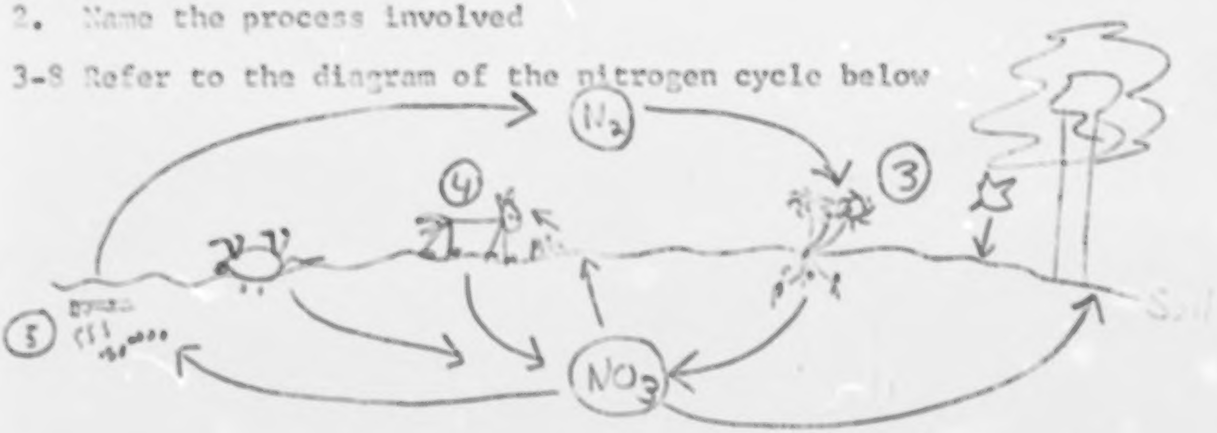
(1)

1-2. choices A) respiration, B) decomposition, C) photosynthesis D) succession, E) fermentation

1. Name the process involved

2. Name the process involved

3-8 Refer to the diagram of the nitrogen cycle below



3. Name the type of plant that has nitrogen-fixing bacteria in its roots.
A) algae, B) maple, C) goldenrod, D) legume

4. By what process does animal #4 produce nitrates? A) exhaling breath, B) excreting wastes, C) symbiotic bacteria, D) by inhaling nitrogen gas

5. What organism produces nitrogen for the atmosphere? A) bacteria of decay, B) nodule, C) denitrifying bacteria, D) tree, E) dead mouse

6. What percent of the atmospheric gas is nitrogen? A) 100, B) 70, C) 50, D) 20

7. In what form do most plants take in nitrogen? A) nitrogen gas, B) protein, C) nitrates, D) nitric acid.

8. What relationship exists between the plant labelled 3 and the bacteria in the root nodules? A) mutualism, B) parasitism, C) commensalism, D) decomposition

---

9. Natural aging of a community is called A) succession, B) eutrophication, C) maturation, D) symbiosis

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10. The first organisms to inhabit an area that has been stripped of life by some disaster (flood or earthquake or fire) are called A) climax organisms, B) pioneer organisms, C) herbaecious organisms, D) saphrophytic organisms

11. In the water cycle, water is returned to the atmosphere by all of the following EXCEPT A) transpiration, B) respiration, C) evaporation, D) precipitation.

12. Nitrogen within the protein of an animal's tissues is returned to nature by A) decay, B) dentrification, C) nitrogen fixation, D) respiration.

13. Eutrophication is the name given to
A) the formation of smog
B) the aging process of waterways accelerated
C) inland salt water seepage
D) phosphate runoff

14. Organisms that convert complex compounds into simple compounds that are then returned to their environment for use by other organisms are best classified as
A) consumers
B) producers
C) decomposers
D) autotrophs

15. The concentration of carbon dioxide in the atmosphere remains relatively constant at about 0.04% as a result of established equilibrium between the processes of
A) assimilation and excretion
B) oxidation and photosynthesis
C) photosynthesis and assimilation
D) respiration and reproduction

16. Name the type of plant that has nitrogen-fixing bacteria in its roots.
A) algae
B) maple
C) goldenrod
D) legume

17. The primary ecological role of green algae is to
A) serve as primary consumers.
B) provide shelter for animals.
C) provide organic food.
D) release carbon dioxide into the air.

18. An example of a community that produces very little of its own food would be found
A) in a meadow.
B) on a forested riverbank.
C) in a cave.
D) in a lily pond.

20. The greatest amount of food production in the world occors in A) tropical forests, B) coastal ocean waters, C) tundra, D) grasslands

21. Many forested regions were once barren rock areas. The sequence of stages most likely to account for this change would be
A) annual herbs--woody shrubs--lichens--mosses
B) lichens--mosses--annual herbs--woody shrubs
C) Shrubs--mosses--lichens--herbs
D) mosses--weeds--trees--lichens

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22. The beech-maple climax forest of northern New York State is part of which world biome? A) tundra, B) taiga, C) coniferous forest, D) deciduous forest.

23. Which sequence is correctly arranged in order of decreasing average temperature? A) desert, grassland, tundra, taiga, B) tropical forest, deciduous forest, tundra, taiga, C) deciduous forest, tropical forest, taiga, tundra, D) tropical forest, grassland, taiga, tundra.

24. Which statement concerning the climax stage of a biotic succession is true?
A) It changes rapidly from time to time
B) It is the stage in which only plants are present.
C) It is not dependent upon the climate.
D) It persists until the environment changes.

25. In a self-sustained ecosystem, which is not essential?
A) a constant supply of energy
B) a living system capable of incorporating energy into organic compounds
C) equal numbers of plants and animals
D) a means of permitting the cycling of carbon between living organisms and their environment

26. A reduction in the activity of decay microorganisms would probably result in
A) a decreased rate of photosynthesis
B) an increased rate of photosynthesis
C) an increased food supply for all organisms
D) a longer life span for all organisms

27. Land biomes are characterized and named by the
A) climax vegetation growing in the region
B) dominant land animal found in the region
C) pioneer organisms found in the region
D) temperatures occurring in the region

28-30. MAJOR BIOMES OF THE EARTH
A) Desert
B) Grassland
C) Marine
D) Taiga
E) Temperate deciduous forest
F) Tropical forest
G) Tundra

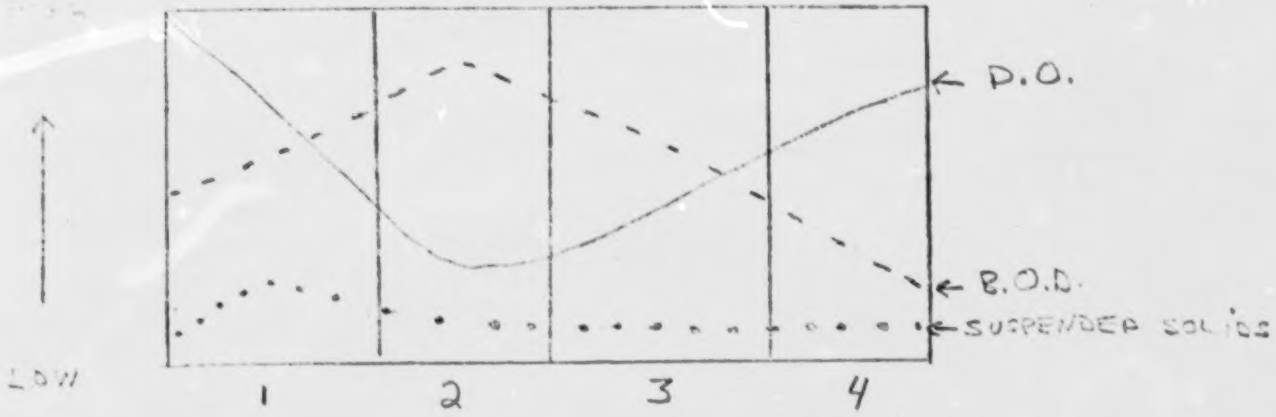
28. Over 80 inches of rainfall per year in this area are evenly distributed so that there is no well defined dry season.

29. Trees in this area have broad leaves that are shed in the fall. The weather is variable with snow seldom lasting all winter.

30. This area has great coniferous forests extending in a broad zone across Eurasia and North America. It has a multitude of ponds and lakes.

31. It is not necessary to fertilize a forest, yet a farmer fertilized his fields. This is because A) the sun is a constant source of energy, B) the sun's energy can be used by the forest better than by the cultivated fields, C) there is much more cycling of materials in the forests than in the fields, D) the roots of the farm plants do not go deep enough to get the necessary nutrients.

32-35. DIRECTIONS: The graph below represents measurements of dissolved oxygen, biochemical oxygen demand, and suspended solids in the water in zones along a stream.



32. In which zone is the amount of sewage the greatest? 1, 2, 3, or 4

33. In which zone would anaerobic decomposition predominate over aerobic decomposition?

34. In which zone would the stream be safest for swimming?

35. In which zone is the level fo dissolved oxygen decreasing most rapidly?

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PART TWO: CHOOSE A OR B (30 points)

A. Design an aquatic food web with at least 4 members that would exist in the clear water zone of a stream. Show how each population in the food web would be affected by:

1) sewage effluents
2) fertilizer runoff containing phosphates
3) excess soil erosion
4) spraying pesticides

B. Describe 3 ways man has upset the following cycles: (be specific)

1) water cycle
2) nitrogen cycle
3) carbon-oxygen cycle

List 4 man-made materials that could be recycled by man.

ECOLOGY
POPULATION STUDY

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NAME________________

WORKSHEET #2

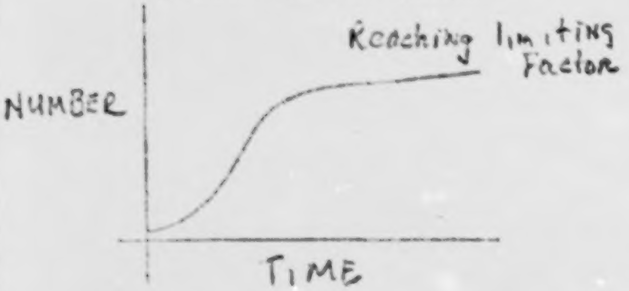
A population is all the organisms of one species inhabiting an area with a given boundary. Species is defined as an interbreeding unit. eg. all the red pines of the Adirondacks, all the cobras in San Diego Zoo.

Limiting Factors are conditions or quantities of essential materials that determine the size of a population.

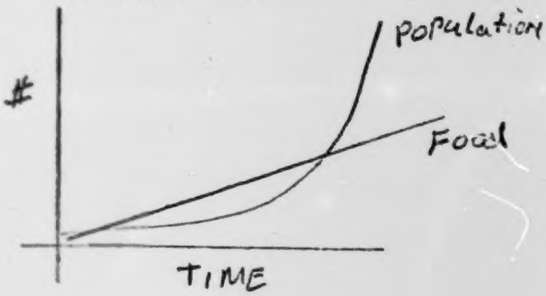
1) List some factors that would limit population size in general.

FLUCTUATION: Populations are constantly changing as result of interactions with other organisms and the physical environment but do to natural checks and balances (predator-prey relationships, available food and space) they tend to remain stable. However, when the natural checks and balances are removed, characteristic growth curves are exhibited.

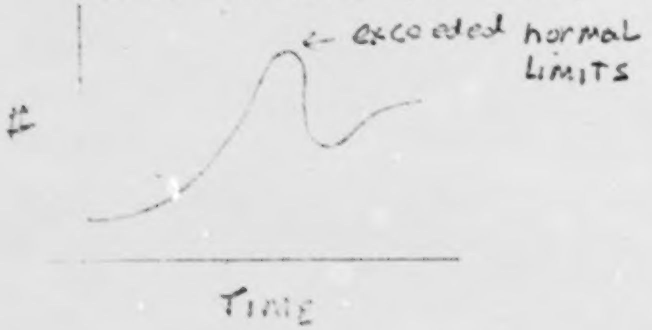
NORMAL GROWTH CURVE "S"



MALTHUS' CURVE



BOOM & BUST CURVE ("J" CURVE)



POPULATION FLUXUATIONS are due to changes in:

1. Natality- number of births
2. Mortality- number of deaths
3. Mobility- degree of migration, emmigration, immigration

How would each of the following affect the size of the snowshoe population in Northern New York? Explain the affect on birth rate, death rate, and overall population size. Sketch a graph to illustrate this fluxuation. (You may be able to justify more than one answer to each).

2. abundant food and space

3. abundant food, limited space, emmigration prevented

4. limited food and space, emmigration prevented

5. disease of the snowshoe hare

6. population explosion of the wolf, its predator

7. inbreeding of a lethal trait such as hemophilia

8. long warm summer with plenty of rain

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LAWS OF LIMITING FACTORS- Organisms have a range of tolerance to factors in their environment and some have a wider range than others. When conditions exceed this level of tolerance they become limiting factors to population size.

Liebig's Law stated that any factor that approached the critical minimum for a species tended to be a limiting factor eg. lack of nitrates in the soil and plant populations.

Shelford's law states that values in excess or a critical maximum as well as values below a critical minimum become limiting. eg. excess nitrates in the soil might also limit plants in that area.

9. Which organism has the wider range of tolerance, carp or trout? List some maximums and minimums that are limiting.

10. How would a population be affected by removal of limiting factors?

11. How can evolution by means of natural selection account for the adaptability of some organisms to a wide tolerance?

12. List the limiting factors for Homeo sapiens. What factors has he removed from his population?

13. Predict the future of man's population and its interaction with limiting factors in his environment.

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ECOLOGY LAB: POPULATION EXPLOSION

Objective: to study the population fluxuation fo a micro-organism over a period of time, graph the growth cirve, and determine the limiting factors affecting this popualtion size.

Materials
MICROBE - paramecium, ameba, euglena, torifer, blepharisma*
5 mm glass tubing
cotton
capillary pipette
dropper
rubber tubing for pipette
20 ml test tubes and rack
Syracuse glasses or watch glass
binocular microscope or good hand lenses
pressure cooker
distilled water
lettuce, dryed medium
5 ml. Na_2HPO_4
bacteria as food source (Pseudomonas)
Bunsen burner
dissecting needle

Procedure

1. Make microtubes for culturing microbe by sealing one end of a 7 cm. piece of glass tubing with a Bunsen burner and flaring the other end with a file. Plug open (flared) end with cotton. (Sterilize).

2. Make medium-
   100 ml. dist. or pond water
   1 g. dried lettuce
   boil 5 min.
   add 894 ml. dist water
   5 ml buffer- Na_2HPO_4
   place in 20ml test tubes, stopper with cotton, sterilize

3. Innoculate medium with bacteria (pseudomonas) uning a dissecting needle and incubate at 37°C for 24 hrs.

4. Using a capillary pipette with a piece of rubber tubing remove some medium containing bacteria from the 20 ml tube and fill 10 micro-tubes (made in step one) 2/3 full.

5, Place some microbe culture in a Syracuse dish and using a binocular microscope and a capillary pipette remove ONE ** microbe to place in each microtube. Replace cotton stopper in micro tube and incubate at 25°C (room temp.)

6. Count twice a day several hours apart.

** remove three if using rotifers

* preferred for size and ease of maintenance

STEP ONE: MICROTUBE

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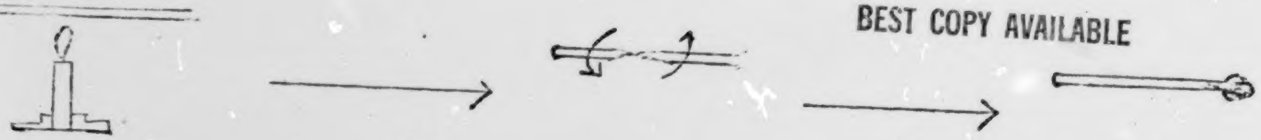
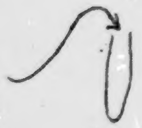


STEP TWO: MEDIUM

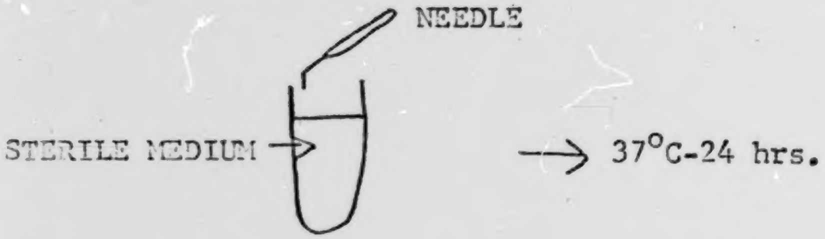
100ml H_2O \
1 g Lettuce } Boil + 894 ml H_2O \
5ml Na_2HPO_4 }



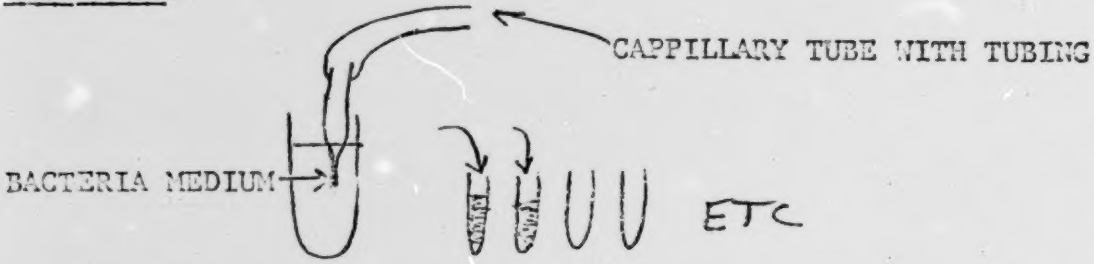
20 ml test tube

STEP THREE: Sterilize microtubes and test tubes of medium then innoculate with bacteria (food for microbe).

STEP FOUR:

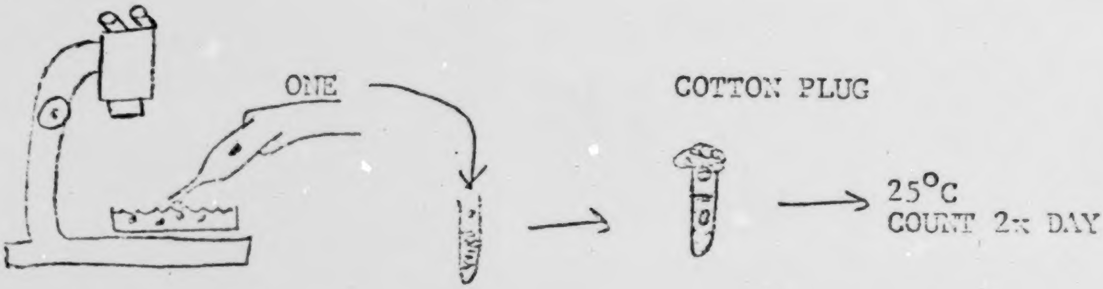

NEEDLE
STERILE MEDIUM
37°C-24 hrs.

STEP FIVE:


CAPPILLARY TUBE WITH TUBING
BACTERIA MEDIUM
ETC

10 MICROTUBES MADE IN STEP ONE

STEP SIX:


ONE
COTTON PLUG
25°C
COUNT 2x DAY

SCOPE & MICROBES

10 MICRO-TUBES

MICROTUBE \
MEDIUM & BACTERIA \
MICROBE WHOSE POPULATION \
IS BEING STUDIED

ECOLOGY LAB REPORT
POPULATION GROWTH

NAME ____________________

BEST COPY AVAILABLE

NAME OF ORGANISM ____________________

DATA: 6 points each

1. Make a data table similar to the one below

date	population count (your data)	population (class av)
day 1		
day 2		

2. Graph the class data and connect the points with a smooth curve.

3. Sketch one of your specimens as seen under the microscope.

INTERPRETATION: 8 points each

1. Define population

2. What type of curve represents the class data? normal growth curve, Malthus curve, boom and bust curve?

3. List 4 factors that might limit the population in the microtube.

4. What is meant by survival of the fittest and how does it normally keep a population in check? (How does competition prevent imbalance or overpopulation?)

5. What circumstances might result in the boom and bust curve?

6. Predict how a population explosion of algae in a pond or stream could affect the stream and its inhabitants.

7. Predict how a bounty (reward for killing) on wolves would affect animals of a Canadian forest. Consider the food web.

CONCLUSION: 8 points each

1. Which growth curve represents human population growth?

2. How does crowding affect the human population?

3. What steps must be taken to check the human population growth?

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DENSITY is the number of organisms of a single species per unit area.
eg. 3 dandelions per sp. ft. of lawn
eg. 100 bacteria per sq. mm on an agar plate

SAMPLING TECHNIQUES: It would be a gross waste of time for an ecologist to take a complete census to determine population size unless he was working with a very small population. Usually one takes a representative sample at random and uses an average (mean density).

1. Direct census- counting each individual

2. Quadrat Toss- A square frame is tossed at random in the area being surveyed and the number of organisms per unit area are counted and averaged. This method works best for terrestrial plants. A convenient size for us to use in our plot study is 30cm. x 30cm. to 50cm. x 50cm..

3. Transect- A straight line is drawn across the area under study using a compass or string. Organisms 0.5m. either side of the line are counted. This is most commonly used for plant populations but also for insects (by a sweeping net), or for aquatic life (dragging a net or dredging the bottom).

4. Lincoln Index (capture-mark-recapture) Specimens are trapped or netted harmlessly, marked with paint or bands then released. A second trapping period follows during which the number of recaptured (marked) animals is compared to the unmarked. The following formula estimates the population size:

$$P = \frac{T\,m}{g}$$

where P= total population
T= total number trapped in second trapping, marked & unmarked
m= number marked in first trapping and released
g= number marked and recaptured
This method works well for most vertebrates including fish

5. Indirect Methods- "signs" indicated by fishing, hunting, food consumption may also be used although with less accuracy.

Project Suggestions:

1. Study population changes in fish (carp), bird (cardinal), mouse, muskrat, etc., in a specific area and explain the fluxuations over 2 seasons (fall and winter or winter and spring).

2. Observe competition between two species of paramecium in a culture.

ECOLOGY
POPULATION LAB: AFFECTS OF CROWDING
(OPTIONAL)

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Devise and carry out a controlled experiment to test the AFFECT OF CROWDING ON A POPULATION. Several specimens are available (fruit flies, bacteria, mealy worm beetle, duckweed, crayfish) and at least one group will be working with each.

First submit your procedure and hypothesis to your teacher for approval and comment. When your plan of attack (procedure) has been approved execute it, collect data, present data in a table and a graph and formulate a conclusion. Include background material obtained through library research about the affects of crowding and other limiting factors. List all references.

NOTE: Be sure to justify your means of determining population size eg. sampling techniques.

ECOLOGY

NAME___ BEST COPY AVAILABLE

HUMAN POPULATION (PEOP--OLLUTION)

THE FACTS: Total population for the earth = 3.6 billion

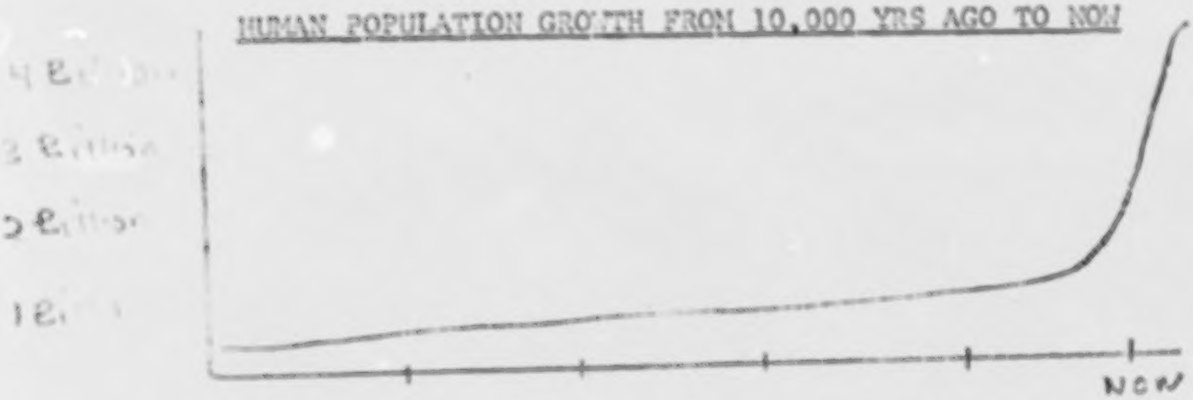
World growth rate = 2% per year (USA = 1.4%)

By 2000AD = 7 billion

By 3000ad standing room = 1 sq. yd. per person

USA may reach 0 population growth by 2000ad (births=deaths)

HUMAN POPULATION GROWTH FROM 10,000 YRS AGO TO NOW



1. What do you predict will happen to the above graph? Will it follow a S or J curve? Explain.

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LIMITING FACTORS: of the human population until the last 2-3 hundred years were famine and disease. There was a high infant rate of mortality and people did not live to be as old.

2. What advances have removed these limiting factors and contributed to the population explosion?

3. What more humane controls than war, famine, and disease can be employed to check population growth?

4. Have technological developments contributed to population growth or control? Explain.

5. About 2/3 of the world's population is undernourished or malnourished. How have the use of plant breeding, fertilizers, irrigation, and pesticides helped to increase tice and wheat crop yields?

6. How does the use of fertilizers, spraying pesticides, building flood dams and deforestation for the purpose of food production affect the environment and wildlife? Explain for each.

7. How does population growth relate to each fo the following? Be specific.

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water pollution
air pollution
land pollution
mineral shortages
energy crisis
crime and violence

8. The following are some of the solutions that have been suggested. Briefly write your opinion on each.

A) Establish a Federal Population Commission with a budget for education and propaganda on population growth problems and controls.

B) Alter tax laws to favor small families by eliminating tax deductions for more than 2 children per family.

C) Make birth control education required in all schools.

D) Legalize physician approved abortion.

E) Federal support for research into population controls.

F) Compulsory birth regulation such as sterilization after so many children or a temporary sterilant in the drinking water with an antidote distributed only to people with a permit to have children.

G) Refuse to ship grain to countries without birth control programs.

FILM STRIP: BIOLOGICAL SOCIETIES

1. Define society.

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2. Give an example of a simple group.

3. What animals exhibit pecking orders?

4. For what purposes do animals bond together?

5. Most complex societies are found among insects. How do they exhibit division of labor?

6. List the castes occupied by termites and the role of the members of each caste.

8. What determines which caste an egg will develop into?

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9. What symbiotic relationship allows termites to digest food?

10. What is the job of each to a black ant society?

Queen and King
worker
soldier

11. How do honey bees exhibit division of labor?

12. Name the stages of metamorphosis in a honey bee.

13. What type of language or communication has been observed in bee societies?

14. How does each member of a social insect group depend on members of other castes?

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ECOLOGY REPORTS

PICK SOMETHING INTERESTION TO YOU

MATING AND COURTSHIP

INSTINCTS

MIGRATION--BIRDS, FISH

NAVIGATION

TERRITORIALISM

COMMUNICATION OR LANGUAGE--BEE FLIGHT PATTERNS

LEARNING

PHOTOPERIODS OR BIOLOGICAL CLOCKS

SOCIETIES--BEES, TERMITES

TROPISMS--TO LIGHT

PECKING ORDER AND HIERARCHIES--BIRDS

PHEROMONES--SKUNK OIL, INSECT ODORS

ATTACK PATTERNS IN SHARKS

OTHERS WITH TEACHER'S APPROVAL

1. Refer to library books.
2. Write the report "IN OWN WORDS" (2 page minimum). Take notes first, then write report.
3. Give 3 min. oral report to class so that we can learn from each other. You may use notes but do not merely read a written report.

ECOLOGY WORK SHEET: TERRITORIALISM

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TERRITORIALISM: Space is a limiting factor and animals defend their home range or territory by various behaviors. In doing so they act instinctively to prevent over-crowding and preserve areas for mating, feeding, living, and resting. Larger animals have larger home ranges eg. a wolf's range may be 5 sq.mi. while a mouse's is less than a sq. acre. It has been found that males usually have larger ranges than females since it is usually their role to defned the territory and to be the aggressor in breeding. There seem to be distinct areas for mating, nesting and feeding in most species that exhibit territorialism. Territory serves as survival mechanism and is especially important during breeding season. Females only mate with males holding territory and only the strongest, most fit males establish territory. A bird, fish, or mammal gets to know his territory well and has the advantage when trying to escape enemies.

EXAMPLES

1. Male birds call loudly to trespassers of their own or different species and display their plumage.

2. Howler monkeys defend their groups (4-35) strangely enough by howling.

3. Dogs urinate on strategic objects to stake out their territory which they defend by barking.

4. Male sunfish, bass and bluegills charge intruders displaying bright fins.

5. Male deer defend their harem and its boundaries by aggressive behaviors.

OTHER ANIMALS THAT EXHIBIT TERRITORIALISM
chipmunks
squirrels
fur seals
most other mammals
most birds- extensively studied
reptiles especially lizards
some arthropods- fiddler crabs, ants, dragon flies
no evidence for amphibians

MIGRATION is a characteristic of certain animals who seasonally change their territories. Examples of some migratory animals who have been studied are:

bison
fur seals
deer
whales
lemmings
birds
eels
salmon
moths
butterflies - small range

QUESTION: HOW DOES MAN EXHIBIT TERRITORIALISM?

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FILMSTRIP "BIOLOGICAL CLOCKS" (OPTIONAL) NAME____________

1. Why is it important for grunions to have a built in timing system to regulate mating and reproduction?

2. What examples show that plants or animals exhibet DAILY RHYTHMS even when kept in constant light?

3. What is a photoperiod?

4. How do humans exhibit biological clocks?

5. List some EXTERNAL TIMERS that organisms respond to.

6. List some INTERNAL TIMERS that organisms respond to.

7. In what way does the moon affect animal rhythms?

8. List some biochemical rhythms exhibited in humans.

9. How do biological clocks give survival value to an organism?

10. What rhythms are exhibited by
    flowering plants
    bees
    birds
    crabs
    mushrooms

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ECOLOGY TEST #3
POPULATIONS

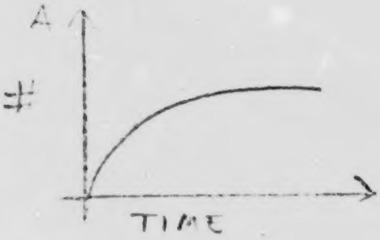
USE ANSWER SHEET

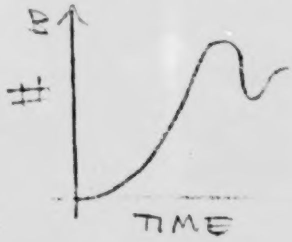
PART ONE (5 pts. each)

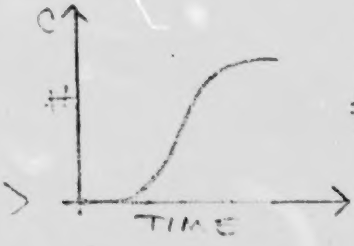
1. A population can be best defined as A) all the organisms inhabiting a small area, B) all the animals in the world, C) all organisms of one species in a defined area, D) the number of plants in a pond.

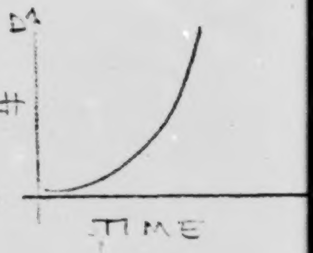
2. As environmental limitations are reached in a large, growing population which normally occurs? A) birth and death rates tend to equal, B) birth rates decrease an death rates remain constant, C) birth rates increase unchecked, D) population approaches extinction.

3. Which graph below represents a population explosion beyond the limits of its environment?









4. Highly organized populations such as ants and termites are called A) communities, B) societies, C) ecosystems, D) biospheres

5. Which is characteristic of natural populations?
A) They tend to remain constant in number
B) They have no size limits
C) They are unaffected by competition
D) They are always cut off from other species by natural barriers

6. Which statement concerning populations is false?
A) A population is made up of individuals of different species
B) Populations respond to favorable conditions by increasing in number
C) Conditions favorable for one population may be unfavorable for another
D) Individuals of a population interact with each other

7. Competition for food, light, or space is probably most severe when
A) closely related species occupy the same habitat
B) closely related species occupy different habitats
C) unrelated species occupy different habitats
D) unrelated species occupy the same habitat

8. The prey populations of a community are strong and healthy because the predators act as a
A) selecting agent
B) source of energy
C) source of essential minerals
D) host

9. Which factor would usually be expected to increase competition among the chipmunk population in a certain area?
A) an epidemic of rabies among chipmunks
B) an increase in the number of chipmunks killed on the highways
C) an increase in the number of hawks that prey upon chipmunks
D) a temporary increase in the chipmunk reproduction rate

10. In most populations, a period of very rapid population growth is usually followed by a period during which the population stabilizes. This stabilization is chiefly the result of
A) a decrease in the number of natural enemies
B) an increase in the supply of available food
C) either an increased death rate or a decreased birth rate
D) the appearance of several new species in the region

11. It is sometimes stated that the human population of the earth today is much larger than it would have been according to the principle of natural selection. If this is so, it is most probably because man has
A) maintained the populations of all other living organisms in a natural balance
B) permitted development of ecological climaxes
C) been developing means of controlling his own environment
D) strictly enforced the conservation laws

12. In a certain population of mice, a small proportion have exceptionally successful protective coloration. If environmental conditions remain unchanged, it is most likely that, in future generations, the proportion of the population with that coloration will
A) increase
B) decrease
C) first increase, then decrease
D) first decrease, then increase

13. A culture of euglena (an autotrophic protist) was prepared in a laboratory. During the first 80 hours the population increased. Therafter it decreased until the euglena died out completely. Assuming no change in physical conditions in the laboratory over the entire period, which is the most probable reason for the decrease in this population?
A) The life cycle of euglena is completed in 80 hours.
B) Toxic waste products accumulated in the culture.
C) The euglena destroyed their hosts.
D) The euglena began to eat each other.

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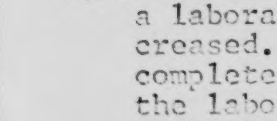
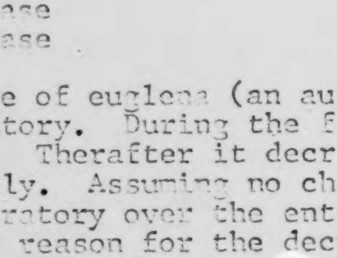
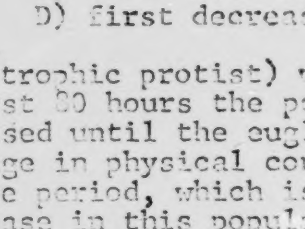
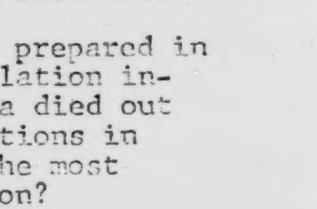
14. Environmental pollution problems are generally most severe in countries having
A) dense population and a limited technology
B) sparse population and a highly developed technology
C) dense population and a highly developed technology
D) sparse population and a limited technology

15. Which graph represents the human population growth?









PART TWO: CHOOSE A OR B (25 points)

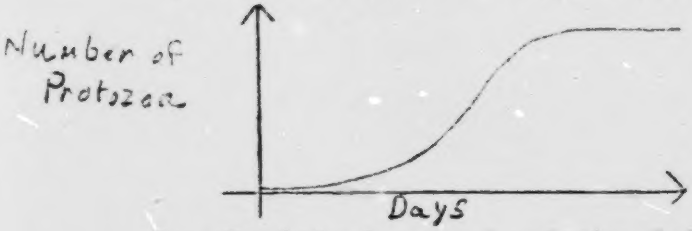
A. A protozoan population was studied in the lab and the following growth curve was plotted.

1. List 5 specific factors that might limit the population size. (Consider both biotic and abiotic factors).

2. Explain why the curve reaches a plateau or leveling off place.

3. How could the popualtion grow more numerous before leveling off.

4. Why has the human population not leveled off yet?



B. Explain how each of the following behaviors can regulate the growth of a population. (3 each).

territorialism

societies and caste systems

migration

communication

biological clocks

reasoning powers

nest-building instinct

courtship instincts

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LAB MATERIALS: 1. QUAD STUDY

Same as those listed in 10th grade curriculum

2. PARASITE LAB:

dissection kit
dissection pan
petrie dishes
eye droppers
Ringer's physiological saline
microscope
slides and cover slips
reference books---see taxonomic keys listed in appendix

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3. D.O.:

D.O. bottles
boiled water
brom blue
straw
carbonated water (soda or alda seltzer)
light source
Hach D.O. test kits
Elodea (Anachris) or Chlorella
aluminum foil

4. INDEX ALGAE:

mayonaise jars
D.O. bottles
pH paper or solutions
thermometers
Hach test kits for D.O. and pH
colorimeter---optional
microscope
slides and covers
eye droppers
reference books---see appendix

5. RELATIVE PRODUCTIVITY:

A. leaf specimens
mortar, pestle, and sand
triple beam balance
drying oven (incubators)
test tubes
graduated cylinders
beaker for boiling bath
hot plate for boiling bath
alcohol
90% acetone
colorimeter and manual

B. D.O. bottles
Hach D.O. kits
foil
light source

6. SUCCESSION:

microscope
slides
cotton fibers
reference books

7. POPULATION EXPLOSION:

(listed on lab)

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UNIT II (6 weeks)

AIR QUALITY

"We have met the enemy and HE is US! - Pogo

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AIR QUALITY

Terminal Objectives

By the end of this unit the student should be able to

1. Recognize the normal composition of air as 78% nitrogen and 21% oxygen.
2. Name the nitrogen cycle, respiration and photosynthesis as natural ways of maintaining the air's composition.
3. Define pollution as an unfavorable alternation of the environment that degrades the quality of life.
4. State four natural sources of air pollution (volcano, dust, pollen, spores, decay, etc.)
5. List the major man-made sources of air pollution and know that automobiles are the number one source.
6. Know that the air contaminant produced in the greatest quantity is carbon monoxide (CO).
7. Distinguish the forms of pollution: particulates (aresols), gases, liquids.
8. Analyze the air quality in several locations using nylon disintegration, sticky tape, Ringlemann charts and dustfall pot techniques.
9. When given a list of air pollutants give the major source, the most harmful effect and a method of control for each.
10. Reconize a list of the symptoms of CO poisoning.
11. Name the pollutants emitted from the buring of fossil fuels (coal, oil, gas) and suggest alternative fuels that pollute less.
12. Recognize the defination and causes of a temperature inversion.
13. Distinguish the London type smog (particulate) and the Los Angeles type smog (photochemical).
14. Consider local weather patterns and pollution and predict the probability of photochemical smogs in the Syracuse area.

15. Match the name of a pollution abatement device such as dust collector, electrostatic precipitator, spray (scrub) tower, adsorber (charcoal) or absorber (limestone) with a description of how it removes specific pollutants.

16. Know which pollutants are monitored and have set standards by the E.P.A. (CO, SO_2, NO, H-C, particles)

AIR POLLUTION WORKSHEET NAME ______________________________

An Introduction - Read pp. 90 - 94 in Env. Poll.

The normal composition at air is 78% nitrogen, 21% oxygen and 1% other gases (CO_2, etc.). These amounts are kept relatively constant by respiration, photosynthesis, water cycle and nitrogen cycle. The sole source of oxygen is green plants.

1. How does water pollution affect the balance of gases in the air?
2. Why is it important for large, inland cities to have parks?
3. How might the gas concentration vary a swamp or marsh?
4. How do the many miles of highways, shopping centers and parking lots affect the composition of air?
5. How does the oxygen concentration vary during winter months?

Pollutants are any substances which can because of their quantity or properties affect the quality of life. The major pollutants are:

CO (carbon monoxide)	47%
SO_2 (sulfur dioxide)	15%
H-C (hydrocarbons)	15%
Particulates	13%
NO_3 (nitrogen oxides)	10%

The sources of these contaminants are:

automobiles	50-60%
industriy	16%
space heaters (furnaces)	15%
natural (volcano, decay, dust, etc.)	14%
waste incineration	4%

The pulprit is the car and carbon monoxide it releases. Other emissions from autos include: hydrocarbons, nitrogen oxides, sulfur oxides, lead and phosphorus. Any machine that derives, its energy from incomplete combustion of fossil fuels (coal, oil, natural gas)release the above contaminants.

6. What industries use fossil fuels as an energy source?
7. How can internal combustion engines be made more efficient?
8. What alternatives are there for transportation other than the gasoline driven car?
9. Relate the number of cars in the U.S.A. to its population.
10. Relate the number of cars, population and miles of highways to the amount of O_2 replaced into the atmosphere.

More Statistics:

I. The Automobile - Produces 60% of air pollution.

   A. 2 1/2 lb. CO (poisonous) for each 20 miles traveled by each car. This would occupy 35 ft^3.

   B. 85% of CO generated in U.S.A. comes from auto exhaust.

      1. U.S. air is 1: 107 parts CO (carbon monoxide)
      2. 1: 10^4 parts CO is dangerous and greater amounts will kill or destroy the brain.
      3. N.Y.C. traffic often exceeds this.
         a. In N.Y.S. 2,500,000 cars drive into the city each day. (In N.Y.C. 60,000 cars are abandoned on the streets each year = no. of autos in the entire city of Moscow, U.S.S.R.)
         b. San Palo, Brazil also has 2.5×10^6 cars.
         c. In Japan, traffic police wear breathing masks. Have oxygen tanks nearby.
      4. The cigarette also produces CO. 1700 ppm from one cigarette.

Project: Hold a clean test tube over flames from

1. candle
2. match
3. poorly adjusted bunsen burner
4. carefully adjusted bunsen burner

Observe the soot produces. This is unburned carbon. The main reason for the unburned carbon is not enough O_2 present.

II. How We Pay

A. Money - about $12 billion in U.S.A. alone. Europe is as bad.

1. crop failure
2. laundry
3. airlines can't fly somedays
4. SO_2 eats automobile tires
5. clothes wear out sooner
6. clean house more often

B. Health

1. Sickness: Between 1955 and 1965 there has been a 300% increase in resperatory disease of children in New Jersey.
2. 1963 Tranksgiving Day - 400 people died in New York City (air inversion).
3. 1962 December and January - London 3-4,000 died.

III. Each person

A. 20,000 inhalations per day

B. 8 liters/min.

C.. 11,500 liters/day

ECOLOGY FILMSTRIP: ENVIRONMENTAL POLLUTION

Atmospheric Pollution   Name ______________________

1. What gas comprises 78% of air?

2. Define pollution

3. List four types of natural air pollution.

4. List in order the three major sources of air pollution.

5. There are two forms of air pollution, gases and aresols. What are aresols?

6. Distinguish the two types of smog:

   London smog

   Los Angeles (photochemcial) smog

7. Complete this chart

Type Pollutant	Major Sources	Damage
Carbon Monoxide (CO)		
Sulfur Oxides		
Nitrogen Oxides		
Hydrocarbons		
Particles		

AIR ANALYSIS LABS

At this point you will set up several air analysis experiments in which certain materials will be exposed to air for 30 days. After one month's exposure you will analyse these materials to determine the quality of the air, degreee and type of air pollution and predict its affect on life (balance of nature).

The class will sample a variety of area's around the school district. Pick a place where the materials will not be disturbed . Suggested sites:

near school smoke stack (shop area)
school swamp or along creek
railroad tracks (Minoa yard, village of E. Syracuse)
air base vicinity
industrial section of E. Syracuse near labs, slaughter house etc.
quiet suburb
construction site or quarry
farmer's field

Record the following information about your site:

Type area: (industrial, rural etc.) ________________________________

Date started: ____

Number buildings within 100 feet ______________________________

Type of wildlife within 100 feet _______________________________

An extension of any of these jobs could be used as yearly project.

AIR ANALYSIS LABS *

#1 STICKY TAPE METHOD FOR PARTICULATE MATTER

This experiment demonstrates the number of larger (20μ- 100μ) wind blown particles in the air.

The wind blown particules that come in contact with a coated paper are deposited on it. An estimate of the number of particles per square inch can be made by comparing the sample with the chart provided.

Equipment

sticky paper or masking tape or fly paper
clear spray lacquer or enamel
comparator chart
mounting stand
glass jar

Procedure

1. A suitable glass jar of approximately 3" in diameter can be obtained by checking various empty food containers. The jar cover should be nailed to a support board which is in an unobstructed spot where the wind can have a clear sweep from all directions. The jar is then simply screwed into its cover for support.

2. Fasten one end of the 2" x '3" strip of sticky paper to the jar with a piece of scotch tape. Wrap around the jar. Remove the release liner to expose the sticky surface. Overlap the ends of the paper to stick them together, so that a total exposed length of sticky paper is 10 inches.

3. Mark the paper on the jar to indicate north. Leave the jar exposed for 30 days. At the end of this period , spray the jar with a clear lacquer to fix the particles collected and to avoid collecting additional particles.

4. In the laboratory divide the paper into eight equal parts representing eight different directions. Mark the proper compass point on each part of the sample. Compare each part with the accompanying chart. Estimate the number of particles collected per square inch from each direction.

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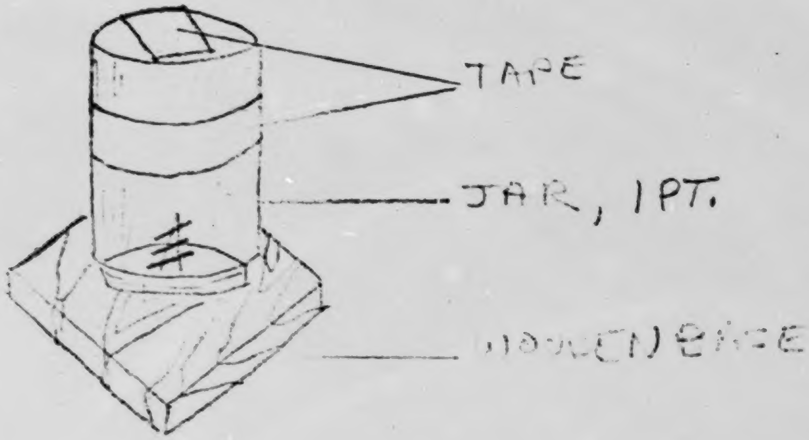
* Labs should be started 30 days in advance of analysis.

#1 STICKY TAPE


TAPE
JAR, 1 PT.
WOODEN BASE

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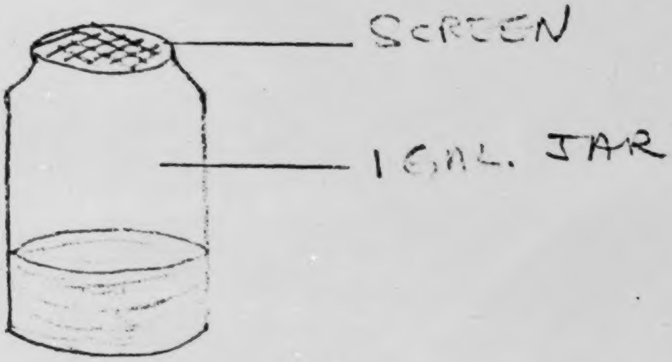
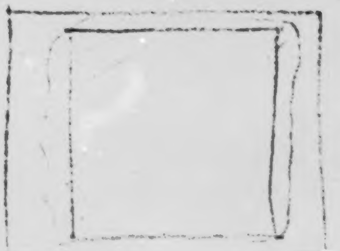
#2 DUSTFALL JAR


SCREEN
1 GAL. JAR

#3 NYLON ON SLIDE MOUNT



LAB #2 DUSTFALL METHOD

The experiment described above is for the determination of particles of sizes ranging between 20 to 100 microns. Experiments can be performed for the determination of settleable particulates and for smaller particles called suspended matter.

Materials

- 1 gallon jar
- screen or cheese cloth
- hot plate
- beaker
- balance
- distilled water
- stirring rod

Procedure

A. Large of settleable particulate matter is determined by the dustfall jar method. In this method, a dustfall jar of known surface area (1 gallon) is exposed to the atmosphere for 30 days. A screen covering the top will prevent animals crawling in and large objects. In winter add isoproryl alcohol to prevent freezing. All the end of this time the jar is taken to the laboratory and its contents washed into a previously weighed beaker. The water is evaporated and beaker dried in an oven at 105°C. and reweighed. The additional weight represents the settleable particulate matter and is expressed as milligrams per square centimeter per 30 days ($mg/cm^2/30$ days). Multiplication of this number by 28.55 converts dustfall to tons per square mile per 30 days. If desired, this residue can be analyzed further for various elements present and for organic and inorganic content. The pH may also be taken before evaporation.

Suspended particulate matter, containing fine particulas is determined by filtering the air sample through filter paper for a known length of time and determining the intensity of the dark spot thus obtained. These measurements are exposed as co-efficients of haze. (COHS).

B. After 30 days.

1. Bring the sample into the laboratory and evaporate most of the water from the jar using a hot plate or water bath. Place an asbestos pad on hot plate to protect jar from breakage.
2. Carefully wash down sides and bottom of jar with a small amount of distilled water from wash bottle, scrubbing all surfaces of inside of jar with stirring rod.
3. Transfer the total sample, a little at a time, to a weighed evaporating dish and evaporate all the water either on a hot plate of water bath. Avoid overheating.

4. When dry, cool the dish and contents and weigh to the nearest centigram or milligram. Subtract the weight of the dish from the combined weight of dish and contents to obtain the net weight of dustfall.

5. Average the results of the three bottles.

Calculations

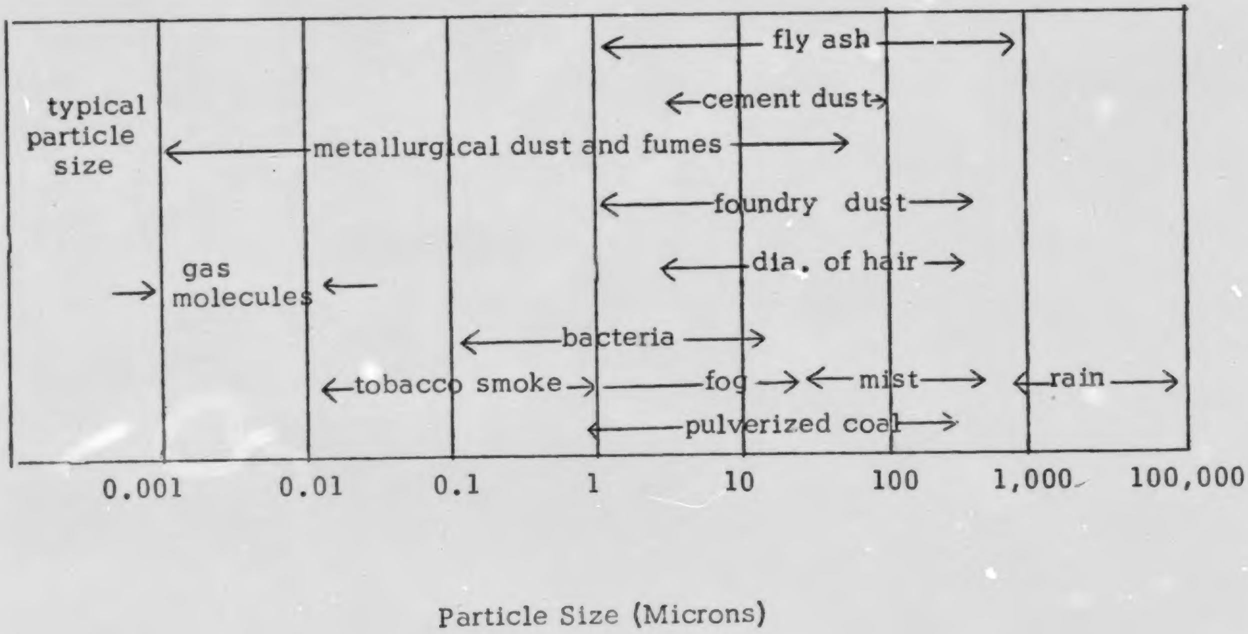
1. Measure the inside diameter of the mouth of each jar in centimeters.

2. Calculate the area of the open mouth of each jar.

3. Determine the dustfall in $mg/cm^2/30$ days.

4. To convert $mg/cm^2/30$ days to tons/square mile/30 days multiply by 28.6 tons/square mile.

An alternativemethod for evaporating the final portion of sample is to transfer it to a volumetric flask, invert the flask over the evaporating dish to form a chicken feeder evaporator, and then evaporate the sample to dryness at about 100°C.


typical particle size
fly ash
cement dust
metallurgical dust and fumes
foundry dust
gas molecules
dia. of hair
bacteria
tobacco smoke
fog
mist
rain
pulverized coal
0.001
0.01
0.1
1
10
100
1,000
100,000
Particle Size (Microns)

Particles - Smoke particles such as unburned carbon (soot).

A. Particle sizes

1. > 10 microns ($1\mu = 10^{-6}$ meter)
    - a. Settles out of air rapidly
    - b. > 40 microus ejected by nose, no problem
    - c. A 20μ particle settles out at 3600 cm/hr in still air. It would fall from a 250 foot smoke stack to ground in 2.1 hrs. This is not a worry.
    - d. A $.3\mu$ particle settles out a 2 cm/hr. It would fall from a 250 ft. stack to the ground in 2500 hrs. It would be in the air for months. This is a worry.
2. $1 - 10\mu$ most common in cities.
3. $.1 - 1\mu$ most common outside of city.

B. The smaller the particle, the worse it pollutes the air.

1. Tobacco smoke is the smallest.
2. Rain has little affect on particles $< 2\mu$
3. Asbestos particles are very small
4. The breaking up of large particles into smaller ones by grinding, spraying, road dust.
5. 150 grams/m^3 of particles in the air will reduce visability from 20 miles to only five miles.

LAB #3 - EFFECT OF AIR POLLUTION ON NYLON

Discussion:

This simple experiment demonstrates the extent of damage air pollution causes to materials. Nylon hose is particularly prone to deterioration from air pollution. This degradation may be brought about by corrosive acid aerosols, particulates carrying sulfuric acid and other chemicals.

In this experiment a piece of nylon is stretched and mounted on a standard slide and exposed to the air for 30 to 90 days. Nylon panels are then examined for broken fibers, with the help of a magnifying glass, microscope or slide projector.

Equipment

nylon panel
wood block side holder or a 35 mm side mount.
magnifying glass or microscope or slide projector

Procedure

1. Examine the unexposed nylon.
2. Insert the nylon panel into the mounting block.
3. Place the mounted sample outdoors in an unobstructed spot. (Preferably on a roof).
4. Allow to stand for 30 days.
5. At the end of 30 days, examine the nylon panel for broken fibers, using a slide projector, magnifying glass or microscope.

Further Suggestions

1. The 30 days exposed sample may be further exposed for 60 more days. (A total 90 day exposure) and examined for further damage.
2. A second sample may be placed indoors for the same length of time (30 to 90 days) and used as a control experiment.
3. Expose nylon to H_2SO_4 or HNO_3 vapors under a hood by removing the container's stopper, then examine.

AIR ANALYSIS DATA

Site	Rain pH	Rain volume (ml)	Weight of solids in rain (mg)	Dustfall mg/cm^2	Particles per square in over 20 microns	Relative nylon disintegrateion (number from one (1) as most)

Sketch of Nylon

Sketch of Tape

AIR ANALYSIS LAB REPORT NAME ______________________________

INTERPRETATION

1. Which sampling site has the most acidic rain?

2. Which sampling site has the most particulate matter as revealed by the dustfall and sticky tape analysis?

3. What conclusions can you draw from the nylon analysis?

4. What type pollutants might affect nylon?

5. Account for the sources of particulate matter collected. (industry etc.)

6. What gasous effluent might account for the acid rainfall?

7. List in order the three major sources of air pollution in the USA.

8. There are two forms of air pollution, gases and aresols. What are aresols?

9. What type industry produces particulate matter? What are the particules composed of?

10. There are two types of smog, the London type smog and the Los Angeles type smog (photochemical). State the difference between the two.

11. What types of damage can be done by air contaiminants?

12. Name the specific gases and aresols produced by the burning of fossil fuels (natural gas, gasoline, kerosine, coal, oil.)

13. Discuss practical methods of preventing specific types of air pollution.

Conclusion

Summarize your results and determine the air quality locally. Suggest practical methods of improving that air quality.

List all of your references. You can include chapter 4 of Enviromental Pollution, the filmstrip "Atmospheric Pollution", and library books.

Point distribution

Data - 15 points

Question 1 - 13 5 each
Conclusion 15 points
References 5 points

AIR CONTAMINATION PROJECTS

1. Testing the effects of a specific gas (SO_2, NO_2, O_3) on various metals, fabrics, plastics etc.

2. Testing the effects of specific gases on various plant species.

3. Building a working model of an electrostatic precipitator, auto emission control device, spray tower, etc.

4. Expanding on the dustfall or sticky tape labs.

5. Recording weather conditions (wind velocity, wind direction, Barometic pressure, temperature etc.) over a period of time and predicting the likelyhood of temperature inversions, smogs etc.

6. Analyzing soot in air using a vacuum filter.

7. Pollen in air at various seasons. Collect with portable (battery operated) car vacuum cleaner.

Many more suggestions are found in the millipore booklets and Environmental Pollution Chapter 7.

8. Detecting trace amounts of Fe, Cu and Zn in the air using qualitative chemistry techniques. (Collect sample on test filter using vacuum syringe and wet it with 6N HCl.)

9. Compare particle emision from different autos or different degrees of tune up or leaded vs. non-leaded gasoline. Use patch test method.

Air Experiment #4 and Field Trip

Density of Smoke

The best method of determining the density of smoke (black) is to use the Ringelmann chart. The relative density is compared to a chart with four sections ranging from light to dark. The chart is held up to the smoke when the observer has his back to the sun and is standing 50-100 feet from the stack. These observations yield no information about steam, white smoke or invisible yet poisonous gases. However when coal or oil is burned by industry the density of black smoke is relative to the quantity of other gases known to be produced by combustion.

Material

Ringlemann Charts
Stop watches

Procedure

At each site* take a Ringelmann observation as follows:

1. Stand with the sun at your back facing the smoke stack and 50-100' from it. Observations should be at right angles to wind.
2. Hold the Ringelmann's chart at an arm's length and look through the center section. Smoke should not be against a dark background.
3. Record the Ringlemann number closest to the shade of the smoke.
4. Repeat at 15-30 sec. intervals for 15 min. and average all readings.

---

* Note to Teacher: Arrange a field trip whereby stops can be made at various industries in your county. Perhaps a tour through one of the plants can also be arranged.

Data: Ringelmann

SITE	NUMBERS				AVERAGE

Interpretation

1. Which industry produced the greatest density black smoke?

2. Name some contaminants that may cause this smoke to be so dense.

3. What industrial process might be the source of these contaminants?

4. Do you suppose that the volume of smoke observed today is the same everyday? Explain.

5. Some factories emit colorless effluents that could not be detected by the Ringelmann Test. What are these gases and how can they be detected?

6. What type of device can prevent black smoke effluents from contaminating our air? Explain its operation.

7. What is the number one source of air pollution?

8. Name the gases produced by this machine. (#7)

9. Describe one practical method of decreasing pollution by this device (#7)

10. Based on your tests of air thus far. What areas of this country are most pollution free?

List Your Reference:

Point Distribution

Data - 15 points
Question 1-10 - 80 points
References - 5 points

ECOLOGY WORKSHEET NAME ______________________

Air Pollution and Weather

Read Environmental Pollution pp. 134 - 136, 139 - 143

1. What is a temperature inversion?

2. What natural conditions cause inversions?

3. How does air contamination increase the chance for an inversion to occur?

4. What type of contamination and what weather conditions together precipitate the London type smog?

5. How would airborne contaminants vary from the village of East Syracuse to a farm in Minoa.

6. List the raw materials and conditions that cause the Los Angeles photochemical smog.

7. Evaluate your area as a potential site for a photochemical smog by considering -
   a. Raw materials (consider traffic, industry etc.)
   b. Reaction cataust (consider amounts of NO_2 produced)
   c. Reaction conditions (consider temperature inversion probability, wind patterns, sunlight)

8. Give some practical solutions for the Los Angeles smog problem.

ECOLOGY WORKSHEET NAME ______________________________

The Pollution Solution: Prevention

It is not practical to collect air, filter out the excess and toxic substances and return it to the atmosphere. There are no polluted air treatment plants as with water. Therefore potential emissions must be treated at their source before they are spewed out into the environment.

1. Describe the functioning of each air pollution control device listed below:
   - a) dust collector
   - b) electrostatic precipitator
   - c) spray tower (scrubber)
   - d) adsorber (charcoal)
   - e) absorber (lime stone)
   - f) exhaust filter

2. Discuss some alternatives to the use of fossil fuels (gas, coal, air) for generating electricity. Consider the alledged energy crisis.

3. Discuss some alternatives (pros and cons) to the autmobile internal combustion engine. Consider nuclear engines, steam turbines, mass transport, electical cars, limits on number of cars per household, limits on horsepower or car size, fuel rations.

ECOLOGY TEST

USE ANSWER SHEET

AIR POLLUTION

Part I (2 1/2 each = 80 points)

1. The process responsible for producing most of the O_2 in the atmosphere is A) carbon fixation, B) photosynthesis, C) electrolysis, D) combustion.

2. The major constituant of normal air (78%) is A) O_2, B) O_3, C) N_2, D) CO_2.

3. The source of up to 90% of the air pollution problem is A) smelting industry, B) cars, C) chemical industry, D) incineration.

4. Which poisonous gas listed is considered to be the largest contributor to the air pollution problem? A) carbon monoxide, B) nitrous oxides, C) methane, D) sulfur oxides.

5. A major source of man-made SO_2 pollution is A) heavy construction, B) insect sprays, C) fossil fuels, D) volcanos.

6. The biggest contributor to CO pollution is A) automobile, B) brake linings, C) nuclear power, D) sewage treatment.

7. NO_2 pollution can mostly be traced to A) smelting plants, B) rubber plants, C) fertilizer plants, D) incinerator plants.

8. Which of the following is NOT a symptom of CO poisoning? A) cramps, B) nausea, C) dizziness, D) headache.

9. Aerosols can best be described as pollutants that A) are gaseous in nature, B) are particulate in nature, C) are dissolved in water, D) are solid wastes.

10. A lung disorder related to air pollution and resulting in air sacs which have lost their elasticity is A) bronchitis, B) malignant tumor, C) emphysema, D) tuberculosis.

11. A pH range of rain water that most animals can tolerate is A) 6-8, B) 2-5, C) 9-12, D) 3-10.

12. Natural sources of air pollution include all of the following but A) volcanos, B) dust storms, C) waste incineration, D) pollen.

13. Which contributes least to a Los Angeles type photochemical smog? A) carbon soot, B) nitrogen dioxide, C) hydrocarbons, D) sunlight.

14. A gas produced naturally be decay is A) CO, B) H_2S, C) NO_2, D) O_3.

15. Driver fatique in traffic jams is mostly due to A) particulates clogging the lung, B) sulfuric acid poisoning the brain, C) hydrocarbons attacking the breathing tubes, D) carbon monoxide attachment to red blood cells.

16. Which of the following contributes most to a temperature inversion? A) Hydrocarbon pollution, B) electric power plants, C) landscape and wind patterns, D) excess aerosols.

17. The most efficient device to remove tiny particales from smoke before it leaves a smoke stack is the A) electrostatic precipitator, B) dust collector, C) limestone filter, D) charcoal absorber.

18. Toxic organic gases (hydrocarbons) can be oxidized to harmless $CO_2 + H_2O$ in a (n) A) septic tank, B) stack filter, C) spray tower, (scrubber) D) incinerator.

19. Which pollutant is incorrectly matched with its source?

Pollutant		Source
A) sulfur oxides	-	nuclear power plant
B) hydrocarbons	-	burning gasoline
C) carbon monoxide	-	fossil fuel, ex. coal
D) fly ash	-	incinerator

20. Which pollutant is incorrectly matched with the prime damage it does?

Pollutant		Damage
A) particles	-	black lung disease
B) carbon monoxide	-	metal and stone corrosion
C) sulfur oxides	-	crop damage
D) nitrogen oxides	-	photochemical smogs

21. A lung disorder related to air pollution and resulting in air sacs which have lost their elasticity is A) bronchitis, B) malignant tumor, C) emphysema, D) tuberculosis.

22. The biggest contributor to asbestos pollution is A) automobile, B) brake linings, C) nuclear power, D) sewage treatment.

23. In New York State the primary source of air pollution is A) home incinerators, B) burning dumps, C) internal combustion engines, D) nuclear power plants.

24. Toxic organic gases (hydrocarbons) can be oxidized to harmless $CO_2 + H_2O$ in a(n) A) septic tank, B) stack filter, C) spray tower, D) incinterator.

25. The best method to measure the density of black smoke from a factory is A) odor detection, B) Ringelmann Chart, C) nylon disintegration, D) sticky tape analysis

26. Which of the following is NOT a fossil fuel? A) uranium, B) natural gas, C) coal, D) oil.

27. The major problem produced by excess hydrocarbons in the air is A) particulate smog, B) photochemical smog, C) breathing tube swerlings, D) plant damage.

28. Which of the following is used to remove sulfur oxides from the air and recycle them as sulfuric acid? A) charcoal adsorber, B) electorstatic precipitator, C) limestone absorber, D) dust collector.

29. Which federal agency sets and monitors ambient air standards? A) FDA, B) PBA, C) EPA, D) WHA

30. Which of the following is most corrosive to stone, cement and metal strucutres? A) sulfur dioxide, B) hydrocarbons, C) fly ash, C) carbon monoxide.

31. Drowsiness experienced by drivers in traffic jams is primarily due to the effects of A) carbon dioxide, B) carbon monoxide, C) hydrocarbons, D) nitrous oxide.

32. Of the following effects which is least likely to be produced by ozone (O_3)? A) leaf spotting, B) smog, C) disintegration of rubber, D) lung cancer.

Part II Choose A or B - 20 points

A. Distinguish between the London type smog and Los Angeles smog. Include for each: 1. defination, 2. type contamination that produces it (raw materials, weather conditions), 4. industries or other major sources of the contaminants, 5. control measures or devices for preventing smog.

B. Incomplete combustion of fossil fuels is a major pollution contributor. 1, define pollution, 2. list four fossil fuels, 3. list four major industries, processes or users of fossil fuels, 4. For each use listed in #3 give an alternative that pollutes less than fossil fuels. If there is not alternative mention that. 5. List some control devices that remove harmful material from fossil fuel emissions and for each name the material removed and describe how it is removed by this device.

UNIT III

WATER QUALITY

(10 weeks)

WATER QUALITY UNIT

ACTIVITIES	OBJECTIVES	OUTLINE	TIME	RESOURCES
Filmstrip: "Freshwater Pollution"	1, 2, 6, 17, 18, 19, 20	A	1 per. 1 hwk.	Ward's Series on Environmental Pollution (70W3800)
Lab "Thermal Effect: On an Aquatic Eco. - System" (D.O.)	3, 4, 5	B.1	2 per. 1 hwk.	E.P. pp. 23-26, 158, 178-179 Hach Titration Kits for D.O. & Instructions
Notes: Relationship between D.O. & thermal pollution	3, 4, 5	B.1	1 per	
Optional Lab - "Temperature Layers"	3, 4, 5	B.1	1 per	
LAB: "Water Pollution and Aquatic Plants" (Phosphates & heat)	5, 6	B.1	3 per 1 hwk.	E.P. pp. 36-44, 56-58, 63-65. Hach test kit colorimeter & manual
Notes: Phosphates, Nitrates and eutrophication	5, 6	B.2	1 per 1 hwk.	
Worksheet: N.Y.S. Standards & water classification	7	B.7	1 hwk.	N.Y.S. Standards Booklet, Parts 700-703, Dept. Environmental Conservation, Henry Diamond-Commissioner
Notes: Introduction to Water Quality Study of Butternut Creek	7	B	1 per	
Film: Membrane Micro-Filtration (35 min)	10	B.3	1 per	Millipore Corporation (free) Bedford, Mass. 01730 or Modern Talking Films 230 Boyleston St. (rental) Boston, Mass. 02167 E.P. pp. 172-174
Lab: "Water Quality of Butternut Creek" Lab Report: "Biotic Potential"	7, 8, 9, 10, 11, 12, 13, 14, 15, 16	B. 1-7	3 outdoors 10 labs see schedule with lab. 1 hwk.	E.P. Chapter 2 F.W.P. Chapter 5 & 6 Hach test kits & instruction Millipore Kit & Booklet D.R. Colorimeter & Manual Engineer's Lab & Manual Standard Methods for the Examinator of Water, Amer. Public Health Assoc.
Notes: CO_2, SO_2, pH, Hardness	14, 15, 16, 17	B.5	1 per 1 hwk.	E.P. Ch. 2

WATER QUALITY UNIT

ACTIVITIES	OBJECTIVES	OUTLINE	TIME	RESOURCES
Notes: Coliform, B.O.D., C.O.D.	[illegible], [illegible], 10, 11, 12, 13, 16, 17	B. 3 B. 4	1 per 1 hwk.	E.P. Ch. 2 Millipore Booklet
Film: The River Must Live (30 min.)	17, 20	A	1 per.	Shell Oil (free) 450 Meridian St. Indianapolis, In. 45204
Worksheet: Water Pollution: Sources & Hazards	17, 20	C	1 per 1 hwk.	E.P. Chapter 5
Film: World in a Marsh (22 min)	17, 20	C. 4	1 per	B.O.C.E.S. Film Library Ward Kimball, A.V. Director, 468-4645
Worksheet & Notes: Sewage Treatment	18, 19	D. 1-4	1 per 1 hwk.	E.P. pp. 155-6, 62-63 Water Pollution, N.Y.S. Ed. Dept., 1967
Field Trip to Treatment Plant (Metro: on Hiawatha Blvd. or Meadowbrook - Limestone on Route 290)	18.19	D. 1-4	1 per 1 hwk.	Water Pollution Causes & Cures, Manufactering Chemists Association 1825 Connecticut Ave., N.W. Washington, D.C. 20009 call: Don Sturrier 477-7574
Optional Lab: "Phosphate & Detergents"	6, 9	B. 1 & 2	3 per	E.P. pp. 42-44, 56-58, 193
Filmstrip: "Marine Pollution"	17,20	E	1 per	Wards Filmstrip Series 70W3800, Environmental Pollution: Marine Pollution #6
Lab practical test	--	--	1 per 1 hwk.	--
Unit test (written)	--	--	1 per	--

WATER QUALITY UNIT

Objective of Investigation

At the end of this laboratory investigation the student will be able to

1. Define pollution
2. List causes of water pollution (sewage, industrial processes, reactor cooling, detergents, agricultural run-off, air contamination via rain, etc).
3. Graph dissolved oxygen (D.O.) vs. temperature
4. Interpret the above graph and state the relationship between temperature and D.O.
5. List the effects of thermal pollution on D.O. and the quality of life in water.
6. Define eutrophication and relate it to D.O., algae growth, phosphates, thermal pollution, stream turbulance and turbidity.
7. Match the New York State Classification of water (AA, A, B, C, D) with its recommended uses.
8. Determine the B.O.D., D.O., SO_4, pH, hardness, Cl, Co_2, and various metals of a water sample from Butternut Creek using the Hach Kits.
9. Determine total phosphate and nitrate of a water sample using the Hach kits and colorimeter.
10. Determine the coliform count by both Hach and Millipore methods.
11. Define B.O.D. and C.O.D.
12. Recognize the importance of B.O.D. as a test of sewage treatment efficiency.
13. Relate B.O.D. to coliform count.
14. Recognize a statement of the relationship between pH and hardness.
15. List the minerals most apt to cause hardness in water.
16. Memorize the N.Y.S. standards for phosphates, D.O., B.O.D., pH and coliform for potable (drinkable) water.
17. Recall the deleterious effects of specific pollutants on aquatic life and human life (ex. disease, eutrophication, low D.O., excess decay, accumulation of toxins)
18. Label the steps and procedures of sewage treatment as primary, secondary or tertiary.
19. Recall the processes occuring in the zones of purification of a stream.
20. Match each of the following types of water pollution with its source and the harm it can do: fertilizers, detergents, pesticides, oil, erosion, heated water, automobiles, sewage, acids, industrial chemicals.

Filmstrip Worksheet
Freshwater Pollution

Name ______________________

1. Describe the water cycle.

2. Why does this cycle not produce new water?

3. Define water pollution.

4. Define eutrophication.

5. What chemicals induce algal over-production?

6. Name the two biggest sources of this type pollution.

7. What is the source of dissolved oxygen (D.O.) in water:

8. How does the following affect D.O.?

   - sewage decomposition
   - thermal pollution
   - algal broom
   - winter freeze

9. Name three diseases carried by contaminated water.

10. How can non-pathogenic coliforms be used as an indicator of pollution by sewage?

11. How many miles does it take for an average stream to reclean itself after being polluted by a city of 40,000 people?

12. What amount of D.O. (ppm) is found in an average clean stream?

13. Draw a stream showing its areas of sewage effluent, active decomposition and recovery. Indicate prominant aquatic species for each area.

14. List four sources of water pollution other than sewage.

Ecology Lab Name ______________________

Thermal Effects on an Aquatic Ecosystem
Ecology

One of the most important limiting factors of the amount of aerobic life in an aquatic ecosystem is the amount of oxygen dissolved in the water (DO). There are many factors which may reduce the DO in such an ecosystem. One such factor is the temperature of the water. Since all aerobic life in a body of water requires oxygen to life (DO) and temperature effects the amount of oxygen, than it becomes important to study and determine how temperature effect DO.

Many industries take cold water from a lake or stream and use it as a coolant for a process that generates heat. When this effluent is discharged back into the stream it may be as much as 20 - 25°C higher.

Predition: Do you predict that cold or warm water will hold more O_2?

Procedure

Beakers of various temperatures ranging from 0 C to 50°C are located around the room. Use the Hach method to determine the D.O. at five different temperatures. Record in the data table below and also on the board.

Temperature 0 C	Your Data D.O. ppm	Class Average D.O. ppm

Hach D.O. Test

1. Fill bottle to over flowing and stopper. Be sure not to trap any air bubbles.
2. Add pillow I (pinkish) and pillow II (white). Restopper and shake. All material will not dissolve.
3. Allow floc to settle half way. Shake a second time and again allow to settle half way.
4. Add pillow III (largest) and shake. A yellow oxidant will form.
5. Fill plastic measuring tube with this sample and pour this amount into the square mixing bottle.
6. Add P.A.O. solution (H_2SO_4) drop wise counting drops and swirling after each drop until the solution changes color (yellow to clear). (titration)
7. All reagents are premeasured so that each drop equals 1 mg/r or 1ppm dissolved oxygen.

   Reagents:
   Pillow I - $MnSO_4$
   Pillow II - Aniodide
   Pillow III - H_2SO_4

Make a graph of the average D.O. at each temperature. Place temperature on the horizontal (X) axis.

Interpretation

Read Environmental Pollution pp. 23 - 26 and 178 - 179.

1. What is the relationship temperature and dissolved oxygen?

2. Why does turbid (cloudy or muddy) water usually have a low D.O.?

3. How does untreated sewage affect D.O.? Why?

4. Explain the relationship between D.O. and presence of phosphates?

5. How do excess algae blooms affect D.O.? Why ?

6. Winter kill and ice prevent photosynthesis during winter months. How do fish get enough O_2 to remain alive?

7. How does thermal pollution affect the quality of life? Explain.

8. What are some ways an aquatic ecosystem can become thermally polluted? Name specific industries etc.

9. Why do trout only live in cold, clear, fast running streams?

10. List the recommended uses for each water classification. The minimum allowed D.O. ppm) in N.Y.S. Class AA, Class A, Class B, Class C, Class, D.

11. List references by author, title and page.

Point Distribution

Prediction	5
Data table	10
Graph	10
Interpretation (1-10)	7 each
References	5

Further Investigations

1. Year round study of D.O. and temperature of a stream.
2. Study of life in aquariums at various temperatures.
3. Study of index species of algae.
4. Varying D.O. temperature and depth of a pond.

LAB

Name ____________________

Temperature Layers in Water

(Optional Activity)

Purpose

Demonstrate how temperature layers can form in bodies of water.

Materials

3 thermometers
1000 ml beaker
3 stands and clamps
ice cubes

Procedure

(1) Fill a 1000 ml beaker 1/2 full of water. (2) Place three thermometers in a beaker at different levels (just below surface, half way down, just off bottom) (3) Allow water to adjust to room temperature CO_2 slightly warmer. (4) Record temperature at time = 0. (5) Add enough ice*to form a layer on top. Until all three thermometers reach the same temperature do not touch the beaker.

DATA

Time	Temp. 0C		
MINUTES	TOP	MIDDLE	BOTTOM

* Different colored cubes can be used to show that the coldest moves below the warmer layer.

Interpretation

1. Explain the changes observed.

2. Why does ice float.

3. Which layer (top, bottom, or middle) of a pond freezes first?

4. Why does a lake never freeze solid?
(Hint: Water reaches its maximum density at 4°C then becomes less dense as its remperature decreases further)

5. How might thermal pollution of a lake in the temperature zone where winter occurs, affect the winter life in that lake?

Note: This lab was adapted from one written by R. Ridall.

Ecology Lab

Name ______________________

WATER POLLUTION AND AQUATIC PLANTS

Objective

In this investigation you will expose duckweed to thermal pollution or phosphate pollution and determine how this population is affected by each. Half the lab groups will do A and the other half will do B.

A. Phosphates

1. Set up the following containers with equal amounts of liquid and mark the water level. Add 10 double leaf duckweed plants to each.

Jar A - clean pond water
Jar B - .5 pp, phosphate solution[1]
Jar C - 1.0 ppm phosphate solution
Jar D - 2.0 ppm phosphate solution
Jar E - 10.0 ppm phosphate solution

2. Incubate at room temperature in normal sunlight. In order to maintain a constant concentration and account for evaporation you may need to add distilled water up to the water mark from time to time.

3. Make a data table, count the number of plants daily and record in data table. Maintain experiment for two-three weeds.

B. Temperature

1. Set up containers with equal amounts of pond water and 10 double leaf duckweed plants. Place them in a well lighted room at the following temperature:

10° C - Cold window sill or refirgerator
20°C - room temperature
30°C - near a 75 watt bulb
40°C - in lighted incubator
50°C - insert aquatic heater

2. Make a data table, count plants daily and record in talbe. Continue observations for two to three weeks.

C. Make a prediction for each of the investigations.

Prediction A

Prediction B

Footnote

[1] potassium phosphate or calcium phosphate may be used. 1ppm - 1mq/l = .001 g/l. A sensitive balance needed.

D. Data Table - Make two data tables and attach to this sheet. Using final average results make two bar graphs (A & B) of class observations.

E. Interpretation

1. How does temperature affect duckweed population?
2. At which temperature does duckweed grow best?
3. How does the addition of phosphate affect the duckweed population?
4. At which concentration does phosphate act as a fertilizer for growth?
5. Define eutrophication (Read Environmental Pollution pp. 63-65)
6. Explain how thermal pollution or phosphate pollution can speed up the natural aging process of a lake.
7. List some sources of phosphate pollution. Read Environmental Pollution pp. 42-44.
8. List some sources of thermal pollution. (Read Environmental Pollution p. 158)
9. How do phosphates affect the amount of dissolved oxygen in the water? Explain how this comes about.
10. As the temperature of water rises what happens to the amount of oxygen dissolved in it?
11. What is the acceptable standard for phosphate (ppm) at spring runoff?

F. Conclusion - Explain how the biotic quality of water is affected by

1. excess phosphates
2. increased temperatures
3. aquatic plant population explosion

E. List References

Point Distribution

Predictions	6
Data	10
Graphs	10
Questions 1 - 11	5 each = 55
Conclusions	5 each = 15
References	4

Name ______________________________

NEW YORK STATE WATER CLASSIFICATION

Ecology Worksheet

Class	Recommended Uses	Standards			Metal Irons
		D.O.	pH	Sewage	
AA					
A					
B					
C					
D					

In which class would you place each of the following (explain)

1. Erie Canal
2. Jamesville Reservoir
3. Onondaga Lake
4. Oneida Lake
5. Lake Ontario
6. St. Laurence River
7. Skanneatles Lake

Name ____________________

"MEMBRANCE MICROFILTRATION"
Millipore Corp.

Film Worksheet

1. What substances pass through the microfilter?

2. What materials are trapped on the filter?

3. List four different investigations that could be facilitated by use of the millipore filter.

Possible Projects

1. Culture bacteria and study its characteristics.
2. Photograph various aquatic microbes with 35mm Pexta x and adapter or poloroid.
3. Compare coliform count at several points along a stream.
4. Relate coliform count to B.O.D.
5. Others in Millipore Booklet

Water Quality of Butternut Creek Name ______________________

For the next 6 - 8 weeks you will be studying the abiotic factors that affect the quality of life (Biotic potential) of Butternut Creek. You will be divided into groups and each group will be assigned to one of four testing sites shown on the included map. Since there is not enough equipment for all groups to preform the same analysis at the same time we will follow this schedule:

	Group 1	Group 2	Group 3	Group 4
Period 1 (Mon) Outdoors	D.O. & Water Temperature and 1 qt. sample → also: take a BOD sample to incubute five days	also: BOD sample to incubute 5 days	also: sample for Millipore coliform assay	also: Hack coliform sample (yellow)
Period 2 (Wed) Lab	phosphate test	phosphate test	set up Millipore filter & incubate	check Hach presumpti coliform test & set up five confirmative tests (green)
Period 3 (Fri) Lab	Nitrate Test 5 day BOD	Nitrate test 5 days BOD	Coliform plate count Sulphate test	Check Hach 5 confirmative tests Phosphate test
Period 4 (Mon) Outdoors	D.O. & water temperature & 1 qt. sample → also take sample for Millipore coliform test	also Hach coliform sample - presumptive (yellow) test	also BOD sample to incubate 5 days	
Period 5 (Wed) Lab	Set up Millipore filter & incubate	Check presumptive test & innoculate 5 confirmative bottles (green)	Phosphate test	Sulphate & nitrate tests
Period 6 (Fri) Lab	Coliform plate count, sulfate & CO_2 tests	check 5 Hach confirmatvie coliform assays sulfate + CO_2 tests	5 day BOD analysis CL & pH	Cl & pH
Period 7 (Mon) Outdoors	Cl Acivity DO & Temp. →	Cl Acidity	CO_2 Hardness	CO_2 Hardness

	Group 1	Group 2	Group 3	Group 4
Period 8 (Wed) Lab	pH Metals: Cu, Fe, Cr, Mn	pH Metals	Acidity Alkalinity	Acidity Alkalinity
Period 9 (Fri) Lab	Alkalinity Turbidity	Alkalinity Turbidity	Metals Turbidity	Metals Turbidity
Period 10 - 14 Lab	Finish all other tests			

* This will be interspearsed with notes and reading assignments on each of these tests.

Ecology - circle your testing site
give units (ex. pp.)

NAME ______________________

Test	Acceptable Standard	Site #1	Site #2	Site #3	Site #4
Coliform Bacteria					
D.O. Range					
Total Phosphates PO4					
Sulfates SO4					
Chlorine Cl					
Nitrates NO_3					
Carbon Dioxide CO_2					
pH					
Acidity					
Alkalinity					
Hardness					
Metals (list)					
B.O.D. (relative stability)					
Turbidity					
Other					

Notes for Water Analysis

1. Sampling:

   Label all samples
   Take several samples from different sources.
   Run analyses on the site or as soon as possible after collection.
   Ideally you should take composite samples: from different seasons, locations depths, times of day. You will probably have time to take grab samples.

2. Coliform Bacteria: (Read Env. Poll. pp. 172 - 174) These bacteria although not pathogenic are commonly found in feces since they are normal inhabitants of the colon (intestine). Other disease-causing bacteria are associated with sewage discharge but it would require many specific tests to detect these. Therefore the coliform test is used to determine the suitability of water and milk for drinking. There are two methods of quantitively detecting coliform: (a) Millipore membrane filtration and colony plat count and (b) Hach lactose broth fermentation (presumptive) test followed by five green lactose-bile broth (confirmative) tests.

Millipore Method of Coliform Analysis in Water

1. Sterilize by dipping in boiling water for three minutes the following: funnel and cover, gray filter support, blue filter base.
2. Sterilize petrie dishes ten minutes in clorox, rinse with water, then ten minutes in 70% alcohol.
3. Sterilize forceps with flame and place filter (white).
4. Assemble apparatus with three rubber caps on filter cover holes and gray filter holder with fiberglass pad (air vent) over fourth hole.
5. Sterilize 1 ml test tube then use to pour 1 ml of test solution (water sample) into funnel.
6. Attach vacuum syringe, cover other hole. Move plunger back, then release. Coliform are now on filter.
7. Place absorbant pad in petrie dish, sterilize ampoule neck of M.F. Endo medium (pink), break and pour over pad.
8. Remove filter from vacuum appratus with sterile forceps and place on media soaded pad in petrie dish. Return cover.
9. Incubate 48 hours at room temperature then 24 hours, at 37C.
10. Remove filter and dry 1/2 hour.
11. Using microscope count colonies and calculate how many per 100 ml.

Reference Millipore Experiments in Environmental Biology, Expt #7, p. 38

(B) PRESUMPTIVE AND CONFIRMED

The following is a Hach adaption of the A.P.H.A. test for coliform bacteria in water. The A.P.H.A. method is the most universally used test for determining concentrations or numbers of coliform bacteria in potable water supplies.

Directions for the Presumptive Coliform Test (yellow)

1. Cut the package and being careful not to touch the cap's inside and add water water sample to fill the tube.
2. Replace the cap and let stand for ten minutes. Shake the tube and invert to fill the gas tube inside with water sample.
3. Place in an incubator for 12 to 24 hours, in the upright position.
4. If a gas bubble has collected in the inverted vial, coliform bacteria are presumed to be present. If no gas has collected allow the sample to incubate for 45 to 51 hours. Gas at this time in any amount will constitue a positive presumptive test. The absence of gas formation at the end of this period constitutes a negative test for this sample. (Relative amounts of coliform (bacterial growth) can be determined among various sample or against a control of distilled water by means of photometric analysis by the DR Colorimeter of the Spec 20)

Directions for the HachConfirmation Coliform Bacteria Test (green)

There are a few unusual types of bacteria outside of the coliform group which will produce a positive Presumptive Test. Therefore, it is necessary to perform a confirmation test to verify the presence of coliform bacteria. The procedure is described as follows:

1. When gas is first observed in a presumptive unit, shake or invert the tube in order to wet the rubber liner of the cap. Exchange this cap with the cap of a new "Confirmation Coliver Tube Assembly". This serves to transfer some fo the bacteria to the confirmation tube. Invert the confirmation tube to complete the transfer of bacteria from the cap into the liquid. This step is to be repeated for five confirmation tube assemblys.
2. Incubate these five tubes for 48 hours. A positive confirmed test for coliform bacteria is indicated by gas collected in the inverted vials within the assembly units. No evidence of gas indicates a negative test.

Bacteria, Coliform: Interpretation of Results of Confirmation Test

The use of five tubes parallels the usual standard method of testing. The following table can be used to estimate the "most probably number" (MPN) of coliform organisms present.

NEGATIVE	POSITIVE	MOST PROBABLY NUMBER PER 100ML
0	5	More then 16
1	4	16
2	3	9.2
3	2	5.1
4	1	2.2
5	0	Acceptable

1. For a given sample, if all five of the coliform tubes indicate negative results, the water is generally accepted to meet the standards set forth by the American Public Health Association (A.P.H.A.).

2. Marginal water is indicated if one or two tubes of a standard five tubes test give positive results.

Carbon Dioxide Test - (CO_2) (Env. Poll. pp. 27-30)

1. Fill plastic measuring tube full of sample and place in mixing bottle
2. Drop clear phemol solution
3. Add NaOH (base) dropwise till pink color develops.
4. 1 drop - 5 ppm CO_2

B.O.D. (biological Oxygen Demand) (Env. Poll. 53-56 & 191)

Oxygen needed by bacteria over a five day period

1. Take two samples in D.O. bottles. Be careful not to trap air bubbles.
2. Determine to D.O. for one bottle*.
3. Incubate (20°C) the second bottle for five days in a dark place. (70-70% of the organic matter will decompose)
4. On the fifth day determine D.O. and subtract it from the first D.O. BOD = $DO_1 - DO_5$
5. B.O.D. is the difference (how much less O_2) between the 2 D.O. readings. It is the most important test of sewage treatment plant effluents. If how ever does not measure oxygen depleation by reducing chemical or non-biodegradable materials

* if this initial D.O. test is very low, areate for five minutes

Phosphate Test (Env. Poll pp. 42-44, 56-58)

1. 20.0 ml sample
2. 2 ml acid (HCl) (line on dropper is 1 ml)
3. Boil ten minutes - do not doil dry. Replace evaporated water with distilled water up to 20 ml line . Cool.
4. 2 ml base (NaOH)
5. Phosver III pillow - allow blue color development
6. Use comparator of colorimeter with filter 2408.

Orthophospates

1. 20 ml sample
2. Phosver III pillow - 1 min. for blue color development
3. Use colorimeter with filter 2408.

Metaphosphates

1. Subtract ortho from total phosphates

Nitrate Test - Colorimeter Manual p. 78 Cadmium reduction method (Env. Poll. pp. 36-40)

1. 24.5 ml demineralized H_2O and 0.25 sample
2. nitraver IV pillow
3. Shake 1 minute - allow four minutes for pink color development
4. Use colorimeter and filter #4445
5. Read, 1 ppm Nitrogen = 4.4 ppm NO_3)

Sulfate Test (Colorimeter Manual p. 119)

Turbidimetric Method or use Hach Kit

1. 25.0 ml sample
2. Sulfaver III pillow
3. Mix-stand for five minutes
4. Use colorimeter and filter #4445

Turbidity - Colorimeter Manual p. 123, Env. Poll. 46-49, 25 ml sample - add nothing filter #4445
Use demineralized water to standardize colorimeter to zero

Secchi Method - For turbidity, use metal disk 20 cm. in diameter divided into two black and two white quarters.

1. Lower disc on calibrated rope into water until it disappears from view.

2. Raise disk till it just reappears

3. Average the two depths and do this three times. A low sefchi reading, ex. 5, means much suspended matter is in the water. A high reading, ex. 30 feet, indicates clear water

or use Hach Kit

Cooper test (Cu) Cuprethol method of Hach kit, colorimeter manual p. 65, filter #4445

Color - colorimeter manual p. 43, Env. Poll. pp, 185-188 Centrifuge sample - add nothing, filter #5543

pH - Env. Poll 31-35

1. Use wide range test paper and compare to hcart (remember 7 is neutral, above 7 is alkaline and below 7 is acidic.

2. Cresol red and colorimeter

NOTE below 4.5 is too acid for fish or bacteria of decay to live.

Acidity test (total) This is the ability of a stream to neutralize bases that might be in it.

1. 6 or 1 sample (fill plastic measuring tube)

2 2. 1 drop phenol phthalein (if turns pink total acidity is 0)

3. Add NaOH (base) dropwise till turns pink

4. # drops x 1/3 = grains persallon - 17 ppm

Alkalinity Test - This is the ability of a stream to neutralize acids in it (natural or man-made sources)

1. 6 ml sample (plastic tube)
2. 1 phenol pillow - (if colorless go to step 5, if pink go to step 3)
3. add H_2SO_4 (acid) dropwise till solution becomes colorless.

(4) 1 drop Acid = 1 grain per gal. (gpg)
(5) add bromcresol green - methyl red pillow _will turn green)
(7) add H_2SO_4 dropwise till turns pink - continue till turns clear
(Record number of drops)

Hardness Test - Env. Poll. pp. 181-184 Hardness is usually caused by minerals such as calcium or magnesium.

1. 6 ml sample (plastic measuring tube-full)
2. Add three drops of solution #1
3. Add 1-2 drops of solution #2, it will turn pink
4. Add solution #3 dropwise counting till a blue color develops
5. 1 drop = 1 grains per gallon = 17 ppm of ($CaCO_3$)

Butternut Creek Water Analysis
Biotic Potential

Name ______________________________

Biotic Potential is the degree to which an ecosystem can support life. It is determined for aquatic environments by the degree of D.O., PO_4. NO_3, SO_4, Cl, pH, hardness, metallic ions, BOD, coliform, type of algae, bacteria, protozoa fish etc. Review chapter 2 in Environmental Pollution.

Attach your data table. Circle your testing site and record data from other sites as well. Be sure to include acceptable standards.

INTERPRETATION

1. From your chemical analysis, list those compounds found in the greatest quantity.

2. List the compounds that exceed the maximum limits for N.Y.S. class C waters (for fishing only).

3. Which testing site seems to exceed the chemical limits more than others?

4. Why does high phosphate data upstream usually result in low D.O. downstream?

5. What is the acceptable coliform count for N.Y.S. class AA & A potable (drinking) water?

6. Quantatively relate coliform count and D.O. (oxygen) and explain this relationship.

7. Coliform bacteria itself is not pathogenic (disease causing) to most mammals. Why then is it a routine test preformed by the state department of health to determine suitability of milk and water for drinking?

8. What might be the polluting source of high nitrates in a rural stream?

9. What might cause a high chlorine or chloride content in a stream?

10. What are some sources of metal ions in Butternut Creek?

11. Read Environmental Pollution pp. 43-56 and contrast BOD (biological oxygen demand) and COD (chemical oxygen demand)

12. What conditions cause a high BOD?

13. Why does the State Department of Environmental Conservation consider BOD the most important test for a sewage treatment plant to make on its effluent?

CONCLUSION

On the basis of your chemical and biological assay of Butternut Creek classify its water on the according to New York State standards (i.e. is it AA, A, B, C, D)? Support your hypothesis and include the limitations of your data.

LIST REFERENCES BY TITLE AND AUTHOR

POINT DISTRIBUTION

data - 15 points
questions - 65 points (5 each)
conclusions - 15 points
references - 5 points

NAME ______________________________

Ecology Worksheet
Water Pollution: Refer to Environmental Pollution - Ch.2

A. For each of the following list two common sources and one hazard to life.

1. D.O. less than 3 -
2. Excess phosphates
3. More than 0.3 ppm nitrates -
4. over 1 ppm CO_2
5. pH less than 6 -
6. Hardwater -
7. presence of coliform bacteria
8. BOD of 10
9. Suspended soilds (silt or mud) from erosion
10. heated water

B. Give the importance of each of the following tests to water quality.

1. D.O.
2. B.O.D.
d. C.O.D.
4. coliform
5. phosphate
6. nitrate
7. sulfate
8. chlorine
9. CO_2
10. pH
11. metalic ions
12. turbidity
13. odor
14. hardness

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Film Worksheet Name ____________________

World in a Marsh

1. Diagram a typical food chain in a marsh

2. Describe the physical conditions of a marsh (abiotic factors)

3. How would each of the following affect the life of the marsh?

    phosphate pollution -

    low D.O. -

    erosion -

    excess algal bloom -

    decay -

    high B.O.D. -

    low pH -

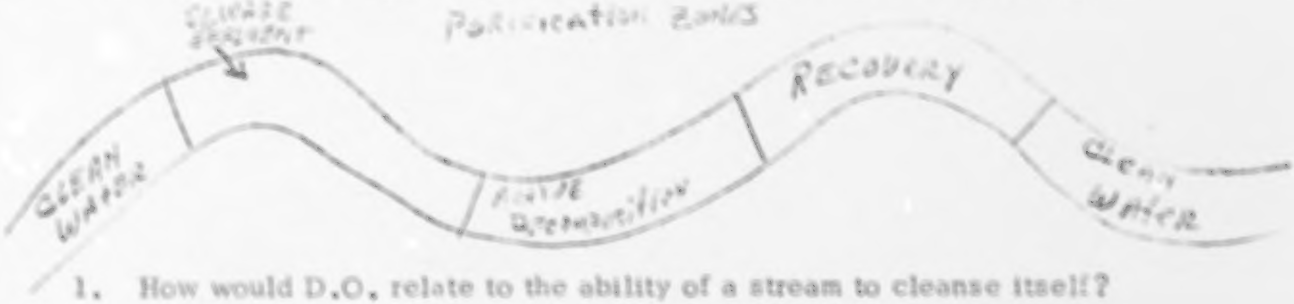
    improper sewage disposal -

    spraying with D.D.T. -

    oil spill -

Ecology Worksheet: Sewage Disposal NAME ______________________________

In days of old all sewage from pioneer cabins, farms and fortifications was placed in rivers and they never became "polluted". Water was still clean and even drinkable (Class AA). Streams have the ability to purify themselves naturally if the quantity of pollution is low. For example, a stream flowing 100 feet /sec. at 25°C receiving sewage from a town of 40,000 cleans itself in eight days over a 96 mile stretch. Most rivers are not long enough to purify themselves naturally with the degree of wastes produced today. Therefore it is necessary to divert wastes through a treatment plant where decomposition of organic material can be concentrated and speed up.



1. How would D.O. relate to the ability of a stream to cleanse itself?

2. Would a stream be likely to do a more efficient job in summer or winter? Explain.

3. Why would it take more time and miles to cleanse a muddy stream?

4. What process occurs in the zone of active decomposition?

5. Which area of the stream would probably have the highest B.O.D.

6. Relate water pollution to population.

7. Describe the process occuring in a septic tank.

8. List the procedures in each of the three phases of modern sewage treatment.

primary

secondary

tertiary

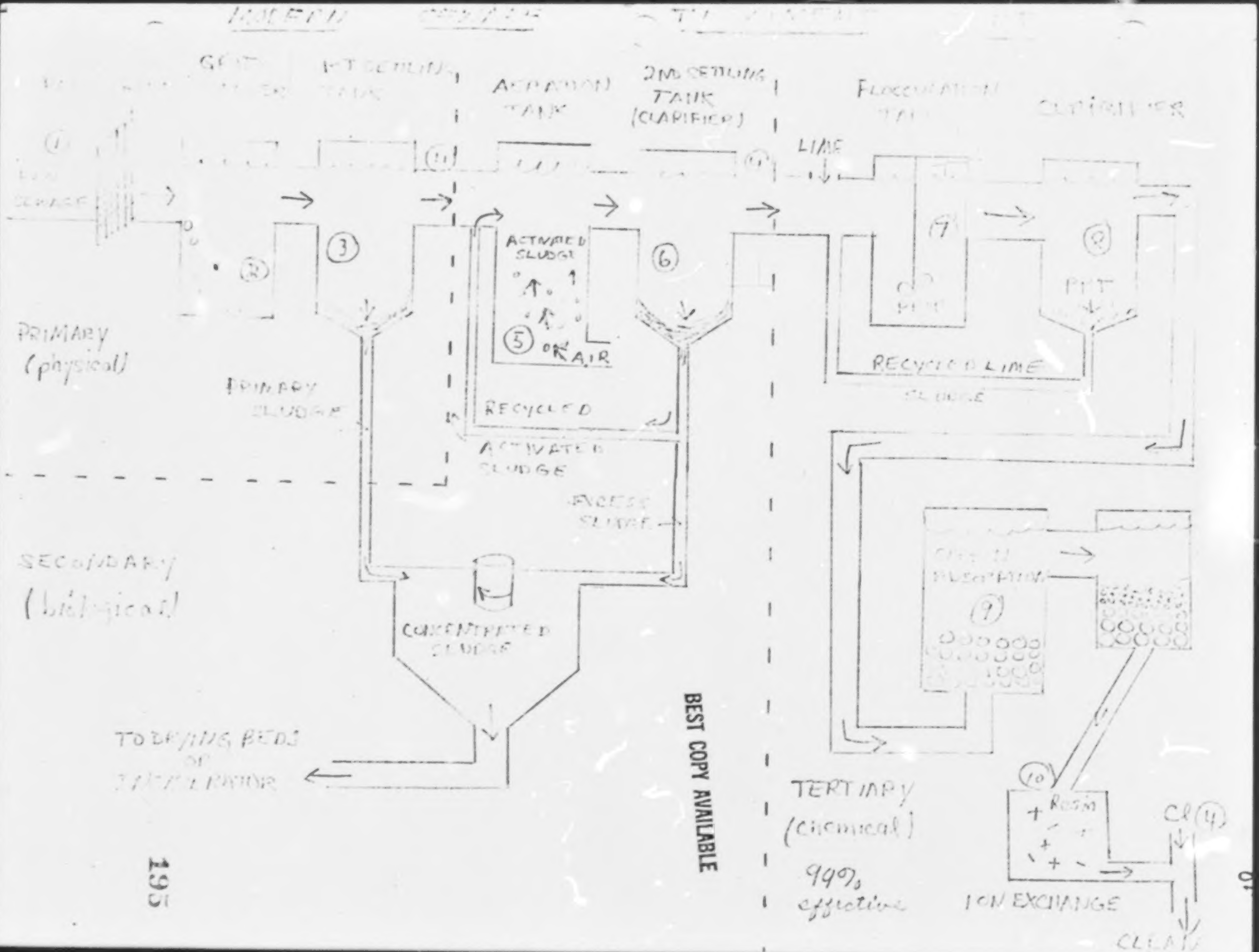
9. Why do few municipalities preform tertiary treatment?

Extra Credit

Investigate sewage treatment laws of other states and countires.

Report on acceptable standards for drinking and swimming regarding coliform

Test sewage effluents for several months.


GRIT
1ST SETTLING TANK
AERATION TANK
2ND SETTLING TANK (CLARIFIER)
FLOCCULATION TANK
CLARIFIER
①
SEWAGE
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
LIME
ACTIVATED SLUDGE
OR AIR
PRIMARY (physical)
PRIMARY SLUDGE
RECYCLED ACTIVATED SLUDGE
EXCESS SLUDGE
RECYCLED LIME SLUDGE
SECONDARY (biological)
CONCENTRATED SLUDGE
TO DRYING BEDS OR INCINERATOR
ADSORPTION
TERTIARY (chemical)
99% effective
Resin
ION EXCHANGE
Cl
CLEAN

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1. Floating objects, sticks and rags are bared from clogging up the machinery by a screen.

2. Stones and pebbles settle out.

3. Suspended matter settles out and is concentrated by the digestor

4. Disinfection by chlorine.

5. Aerobic bacteria of decary naturally decompose organic matter.

6. Suspended matter (sludge) settles out.

7. Alum or lime causes chemicals (NO_2 + PO_4) to clump (coagulation) together and fall to the bottom more easily.

8. Chemicals precipitate out of solution.

9. Carbon adsorbs all dissolved organic matter that might produce undesirable tastes and odors.

10. Resins of positive or negative charges attract ionized mineral salts and remove them from the water.

SEWAGE TREATMENT NAME ______________________________

Field trip to treatment plant

1. List the steps in order preformed by the Butternut Creek Plant to treat influent water and sewage. Identify which are primary, secondary, and tertiary.

2. How is this plant's efficiency affected by spring melt and high water?

3. Do storm sewers empty into this plant too?

4. How many Sq. mi. of territory are covered by this plant?

5. What large industries contribute waste water to this facility?

6. What percent of Onondaga County's waste water receives more then primary treatment?

7. Complete this chart.

	Standard Acceptable level	Plant Effluent Level
Coliform		
Phosphates		
Chlorine		
D.O.		
B.O.D.		

Lab: Phosphate and Detergents (optional)

NAME ______________________________

Introduction:

Phosphate - Read Env. Poll. pp. 44 - 56

Phosphates are widely used in municipal and private water systems, in boiler feed water, in household and industrial detergent formulations, in fertilizers for agriculture, etc. In order to properly utilize this useful chemical in water systems and boilers, one must know accurately the amount present in the system being treated.

There is, moreover, a need to analyze the phosphate in waste streams and in natural bodies of water. A certain amount of phosphate may be beneficial in a natural body of water, but too much phosphate can result in eutrophication, or over fertilization of the body, with the result that organic aquatic vegetation grow too rapidly, dies in the body, and by decaying consumer large amounts of dissolved oxygen from the lake or stream. (See Dr. Jackson's Film Strip Environmental Pollution "Freshwater Pollution" i.e.: Summer Kill)

Phosphate is found in three forms: (1) organically bound, (2) meta (poly) and (3) ortho. The determination of organically bound phosphate requires a special digestion procedure not described here (see standard methods). It is not normally of interest except to the biologists. Meta (or poly) phosphate is a complex phosphate which must be reduced to ortho (simple) phosphate by boiling in the presence of acid. This procedure is described below. Meta phosphates are the ones commonly used in treating water systems and boilers, as well as in detergent formulations. After being dissolved in water, meta phosphates are converted into ortho phosphates at different rates depending upon their types, the temperatrue of the water and the pH of the water.

Lab Report: Phosphates in Detergents NAME ______________________________

Procedure

1. Bring samples of powdered or liquid detergents. Make 1.0% solutions.
   A. Dry detergent - 5g/500ml H_2O
   B. Liquid detergent - 5ml/455ml H_2O

2. Use Hach kit and follow directions to test total phosphates. Employ the bioled acid technique then take a reading, with the colorimeter. Also test the amount of orthophosphate and calculate the metaphosphate content.

Total phosphate - orthophosphate = metaphosphate (in detergents)
Most conventional sewage treatment plants remove only 30% of the phosphates. Before the phosphate ban nonbiodegradable meta (poly) phosphates were found in detergents. A substitute cleaning agent, trinitrolacetrate (TNA), is now being used.

OBSERVATIONS: ppm (part per million)

Detergent Brand	Total	Ortho	Meta*

Also make a bar graph for total phosphate. (10 points)

DISCUSSION: (10 points each)

1. Why has New York State banned the presence of phosphate in detergents as of June 1, 1973?

2. What type of sewage treatment is needed to remove phosphates from residential wastes?

3. How do excess phosphates affect the lakes and streams they eventually flow into?

4. What sources other than detergents cause phosphate pollution?

5. How does excess phosphate affect dissolved oxygen? Explain how this comes about.

6. Define Euthrophication and explain how this process is accellerated by phosphate pollution.

7. What is the acceptable standard for phosphates in ppm for water at spring run off?

REFERENCES: List Title and Author (5 pt.)

Extra: Compare N.Y.S. laws regulating phosphates with those of other states and federal standards.

Filmstrip Worksheet
Environmental Pollution #6 Marine Pollution

NAME ____________________

1. List four characteristics that distinguish freshwater and marine water.

2. Relate air pollution and freshwater pollution and land pollution to marine pollution.

3. Define estuary and name one along the east coast.

4. Explain how each of the following is a source of pollution to costal waters:

   fertilizers
   duck farms
   sewage
   soil erosion
   red tide
   heated water
   oil slick
   DDT
   automobiles

5. Distinguish zooplakton and phytoplankton.

6. Trace DDT through a typical costal food web.

7. List four ways man uses the oceans.

Ecology Exam
Part I: Lab Practical

NAME ______________________________
Sample ______________

You will be given a water sample. During the 45 minutes period you must budget your time so that you can preform the following analyses:

1. metaphosphate - (total) boiling acid method
2. dissolved oxygen - Hack kit method
3. pH - Hach colorimater method or hardness - Hack kit method

Your Data is to be turned in at the end of the period.

total phosphates ____________ list units

D.O. ____________

pH or hardness ____________

Additional data

Coliform	200/100 ml
Nitrates	30 ppm

INTERPRETATIONS - Take home portion not to be discussed with classmates.

1. Explain the relationship between the coliform count and D.O.

2. Explain the relationship between phosphates and D.O.

3. Explain the relationship between pH and hardness.

4. What circumstances in the environment would account for the coliform count?

5. What might be the source of the nitrates in the water?

6. Do you hypothesize that the BOD of this stream would measure greater than 4 or less than 4? Fully explain your answer.

LIST ANY REFERENCES YOU ALLUDED TO

Ecology Test
Water Quality

NAME ______________________________

______ 1. Water can be defined as hard if it a) contains excess oxygen, b) has sewage dissolved in it, c) has minerals dissolved in it, d) has a high pH.

______ 2. Accelerated aging of a pond stimulated by phosphate pollution is called a) tertiary treatment, b) eutrophication, c) thermal pollution, d) denitrification.

______ 3. Nitrate pollution can be mostly traced to a) smelting plants, b) hospital wastes, c) incinerator plants, d) fertilizer plants.

______ 4. Two sources of carbon dioxide (CO_2) in water are limestone and a) fertilizers, b) respiration, c) photosynthesis, d) pesticides

______ 5. Class A water can be used safely for a) fishing, b) drinking, c) irrigation, d) all of these, e) none of these.

______ 6. The most polluted water that can be used only for navigation or industrial processes is classified a) AA, b) A, c) B, d) C, e) D.

______ 7. Which type of sewage treatment is 95% effective in restoring water physically, biologically and chemically? a) primary, b) secondary, c) tertiary.

______ 8. The pH of water that most animals can tolerate is a) 6-8, b) 2-5, c) 9-12, d) 3-10.

______ 9. The minimum amount of dissolved oxygen (DO) required by most aquatic organisms is a) 0.1 ppm, b) 3.0 ppm, c) 15 ppm, d) 35 ppm

______ 10. The major cause of increased phosphate pollution in water is a) sewage, b) atomic power plants, c) detergents, d) industry.

______ 11. A disease transmitted by polluted water is a) hepatitis, b) cancer c) measles, d) enphazema.

______ 12. A high count of coliform bacteria is an indicator of a) sewage pollution, b) phosphate pollution, c) excess D.O., d) hard water.

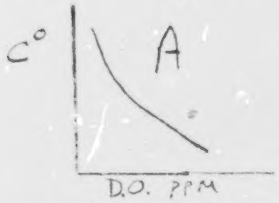
______ 13. The allowable amount of phosphate in water at spring run off is a) 0.015 ppm, b) 1.5 ppm, c) 15 ppm, d) 115 ppm.

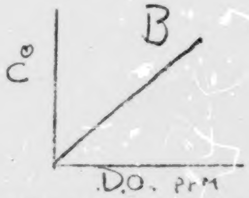
______ 14. The hardness of water is measured in a) ppm, parts per million, b) grains per gallon, c) milligrams per liter, d) pH units.

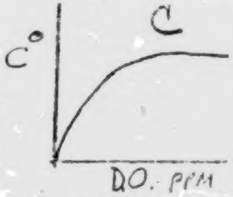
______ 15. A sewage treatment plant is located on a stream. The water upstream from the plant is called the clear water zone. A zone of sewage effluent then follows. What is the next zone of the river called? a) aquatic zone, b) recovery zone, c) active decomposition zone, d)marine zone.

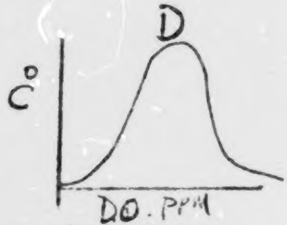
______ 16. As the coliform count in a stream increases what happens to the amount of oxygen dissolved in the water? a) increases, b) decreases, c) remains the same, d) no definate relationship.

______ 17. Which graph shows the relationship between dissolved oxygen in a water sample and it's temperature?









______ 18. A student observes a "rainbow effect" when he pulls a tree branch over the surface water of a pond. He correctly concludes that the water has been polluted by a) nitrates, b) oil, c) brine, d) ammonia.

______ 19. Coliform counts in excess of 50/100 ml. in drinking water cause concern for what reason? a) coliforms are highly contagious to humans, b) coliforms are associated with sewage, c) coliforms transmit dysentery, d) colifroms remove too much DO from water.

______ 20. In the water cycle, wateris returned to the atmosphere by all of the following EXCEPT a) transpiration, b) respiration, c) evaporation, d) precipitation.

______ 21. Which of the following are biodegradable materials? a) human sewage, b) plastics, c) old cars, d) phosphate fertilizers.

______ 22. Physical and biological treatment but no chemical treatment is characterisitc in which type? a) septic tank, b) primary, c) secondary d) tertiary.

23 - 27 MATCHING - In which phase of sewage treatment does each occur?

______ 23. septic tank
______ 24. screening out suspended soilids
______ 25. aerobic digestion of sludge
______ 26. removal of chemicals ex. phosphates, sulphates, nitrates
______ 27. chlorination

a. primary treatment
b. secondary treatment
c. tertiary treatment
d. primary, secondary and tertiary

______ 28. The primary reasona water sample may show a lod SO (dissolved oxygen) content could be a) sewage effluents, b) fertilizer run off, c) mercury, d) lack of fish.

______ 29. BOD of a stream measures the amount of a) dissolved oxygen, b) oxidation by metalic ions, c) O_2 used by organisms, d) coliform bacteria, e) none of these.

______ 30. The most important test of efficient sewage treatment that should be performed before the effluent flows into a lake is a) BOD, b) metaphosphate, c) DO, d) chlorine.

______ 31. The minerals responsible for hard water are a) NO_3 & Ca. b) Ca & Mg, c) NO_3 & Fe, d) Cl & Mg.

______ 32. Which of the following water test is most inclusive of the others? a) BOD, b) DO, c) COD

______ 33. The type of water pollution produced by nuclear reactors is mostly a) thermal, b) phosphate, c) oil slicks, d) excess D.O.

______ 34. Which offers the best explanation why the spraying of DDT to kill mosquitos is harmful to all organisms in the community. a) Mosquitos are an important link in the food web and their extinction would decrease all populations. b) Toxins from DDT accumulate an porganisms tissues in greater quantities as they move up the food web. c) DDT kills all algae seriously decreasing food and oxygen for fishes. d) Mosquitos develop a resistance to DDT, overpopulate and increase all populations involved in the food web.

______ 35. When using the Hach Kit to test for dissolved oxygen each drop of acid required to change the solution from yellow to clear is equal to a) 17 grains per gallon, b) 10 parts per million, c) 1 part per million, d) 5 milligrams per liter.

Below is an aquatic food web. How would each of the following affect the trout population? Increase or decrease and why?

Algae ⟶ Protozon ⟶ Daphnia ⟶ Crayfish ⟶ Crub ⟶ Trout

(5 points each)

1. 1. Spraying along the shore with pesticides.

2. Population explosion of crayfish.

3. Increased coliform bacteria.

4. Population explosion of algae to the point of eutrophication.

5. Heated water from a turbine.

B. Define water pollution and distinguish natural from man made causes. (5 points)

Lab Materials:

Thermal Effects on an Aquatic Ecosystem:

5 hach D.O. Kits and Extra Pillows (for class)
5 B.O.D. Bottles
5 Thermometers
5 1000 ml 6 cakers
ice and styrofoum container
hot plate
pond water at 5 different temperatures. 0°C, 10°C, 20°C, 30°C, 40°C
graph paper

Temperature Layers in Water (per lab group)
3 thermometers
1000 ml beaker
3 stands and clamps
colored ice cubes

Water Pollution and Aquatic Plants (per lab groups)
A. Phosphates
duckweed
5 baby food jars
distilled water
calcium phosphate
triple beam balance

B. Temperature
duckweed
5 glass jars
distilled water
5 thermometers
75 watt bulb and socket
lighted incubator
aquarium heater
refrigerator

Water Quality of Butternut Creek

- Hack kits
- Millipore Kit for coliform
- Hach coliform tubes
- colimeter and chemicals and manual
- Hack engineering lab (portable)

Phosphates and Detergents

- Samples of detergents produced before and after June 1, 1973
- Triple beam balances
- Distilled water
- Flasks and stoppers
- Phosphate test kit (Hach)
- colorimeter

Lab Practical

- Hack D.O. Kits
- Hach D.O. Kit
- Aide range pH solution
- Hardness solutions
- Colorimeter and manual

TESTS PERFORMED BY ENGINEER"S LABORATORY (PORTABLE) See Water Test Kits

Acidity, free and total
Alkalinity
Bromine
Carbon Dioxide
Chlorine
Chloride
Color
Copper
Fluoride
Hardness, Calcium
Hardness, Total
Hydrogen Sulfide
Iron
Manganese
Mitrate, Nitrogen
Nitrite, Nitrogen
Oxygen, Dissolved
pH, wide range
Phosphate, Ortho and Meta
Silica
Sulfate
Terbidity

TESTS PERFORMED BY ENGINEER'S LABORATORY USING COLORIMETER CHEMICALS (See labeled shelves)

Aluminum
Barium
Chromium
pH Cresol red (6.5 - 8.5)
Tannin-lighin
Zinc
Hydrazine
% Transmittance

TESTS PERFORMED BY DR. COLORIMETER: (Chemicals are in Dr. El. Engineer's Lab) (*Chemicals are on labeled shelves) (# Tests may be performed but no chemcials are yet available) (See Water Test Kits p. 18)

*Aluminum
*Barium
Boron#
Bromine
*Chlorine
*Chpomate
*Color
*Copper
Cyanide#
Cyanuric Acid#
Detergents#
Fluoride
Hydrazine *
Hydrogen Sulfide
Iodine #
*Iron
Manganese
Mercury#
Nickel#
*Nitrogen, Nitrate
Nitrogen, Nitrite
Oxygen Demand, Chemcials#
Oxygen Demand, Index#
*pH Cresol Red
*pH Wide Range
Phenol#
*Phosphate
Selenium#
Silica
Silver#
Sulfate
*Tannin-lighin
Terbidity
Volatile Acids#
*Zinc (Read directions!!)
*% Transmittance

OTHER TESTS KITS AVAILABLE FOR USE: SEE SHELVES

Chloride
Chlorine
Copper
Coliform
Phosphate
Manganese
Chromium
Sulfate

Dissolved Oxygen (with sampler)
Iron
Relative Stability - B.O.D.
Carbon Dioxide
Acid - Alkalinity
Hardness

OTHER ECOLOGY RELATED PROBLEMS

UNIT IV

(4 WEEKS)

LAND POLLUTION

NOISE POLLUTION

RESOURCE SHORTAGES

ENERGY CRISIS

ENDANGERED SPECIES

LEGISLATION

POUNCE ON POLLUTION!

UNIT IV: OTHER ECOLOGY RELATED PROBLEMS

Terminal Student Objectives:
Upon completion of this unit the student should be able to........

1. List examples of solid wastes and identify those which are non-biodegradable.
2. When given a type of land pollution pick its major negative effect on the environment.
3. Give an advantage and disadvantage for each of the following solutions to solid waste disposal: sanitary landfill, incineration, grinding and shredding, composting, reuse and recycling.
4. Identify those natural resources that are depleted or in critically short supply.
5. State three methods of producing electricity and give advantages and disadvantages of each method.
6. Distinguish reuse and recycling.
7. Pick from a list those materials that can be easily reused or recycled.
8. Explain some of the problems of recycling.
9. When given a list distinguish those species that are endangered, those extinct and those in no present danger of extinction.
10. List causes for wildlife extinction.
11. Pick from a list those noises that are usually present in enough decibels to cause distress or damage.
12. Know that a decibel is a unit of sound.
13. List some health hazards of excess noise.
14. Know that the E.P.A. (Environmental Protection Agency) monitors air pollution, water pollution, pesticide use, auto emissions, and solid waste disposal on a nationwide basis.
15. Know that the New York State Department of Environmental Conservation (D.E.C.) monitors use of state owned lands, hunting and fishing regulations, water quality, air quality, waste water treatment plants, solid waste disposal.
16. List specific pollutants that have some state or federal regulation for abatement.
17. Match a specific pollution problem with the most practical method of controlling it.
18. When given a municipal proposal (e.g. rezoning, building a new shopping plaza, housing development, bond issue for sewage treatment plant, etc.) discuss all the political, social and ecological arguments for and against the proposal.

ECOLOGY NAME____________________

Filmstrip Worksheet:

ENVIRONMENTAL POLLUTION (WARDS 70W 3800)

#5 SOLID WASTE POLLUTION

1. Define land pollution.

2. List 5 types of solid wastes and circle the most common one.

3. Each of the following is a method of disposing of solid wastes. Explain each and give one drawback to each method.

   sanitary landfill
   incineration
   grinding and shredding
   composting
   reuse or recycling.

4. Define non-biodegradable and list some non-biodegradable wastes.

5. Distinguish solid wastes from chemical wastes.

6. Why are pesticides, insecticides, herbicides or fungicides referred to as BIOCIDES?

7. Trace DDT through an aquatic food web and show how each level can be affected.

8. How can radioactive fall out be considered pollution?

FILM WORKSHEET NAME____________________

THE STUFF WE THROW AWAY

1. List some materials you throw away almost daily.

2. Define biodegradable and pick some examples from your list from #1.

3. List some ways you could slightly change your living habits to contribute less to the solid waste problem.

4. In what way are we part of a "disposable society"?

5. Observe your family for 1 week. How many standard grocery bags of garbage did you throw away?

6. Call the Town fo Dewitt or Town of Manlius offices and find out how and where solid wastes are disposed of in your town.

ECOLOGY WORKSHEET

NAME________________________

NATURAL RESOURCES

1. What natural resources are in great shortage today?

2. What resources are in great supply?

3. What is the "energy crisis"?

4. What methods are available for the production of electricity?

5. How does a nuclear reactor work?

6. Compare the pollution problems produced by a nuclear reactor and fossil fuel when they are used to make electrical power.

7. Distinguish reuse and recycling.

8. List some materials that can be recycled.

9. What are the problems with recycling that discourage more companies from doing it?

10. Name some items in your home that could be reused or recycled but are thrown away instead.

11. What can be done to alleviate the natural resource shortages?

NOISE

I. The unit of sound loudness is called the decibel.
  A. This scale is a logarithmic scale and is based on the way the human ear hears loudness.
  B. All sound powers are compared to a set standard, the threshold of hearing,

$$I = 10^{-16} \frac{\text{WATTS}}{\text{cm}^2}$$

(note: The ear opening is about 1 cm^2 in area).
  C. Here are examples of the difference between two sounds of different loudness.

1 db difference	smallest change perceptible.
3 db difference	moderately noticeable, means one sound has twice the power of the other.
10 db difference	One sound seems twice as loud as the other but actually has 10X the power. (Remember: this is a log scale to the base 10).
60 db difference	One sound has 1,000,000 times the power of the other.

POSSIBLE PROJECTS

1. Investigation of the effects of the S.S.T.

2. Tape recordings of common but often ignored sounds.

3. Relationship between stress, noise and violence in urban areas.

4. Health hazards of noise pollution.

5. Maximum noise levels in various states.

6. Effect of various amplitudes on mice.

7. Relationship between noise levels and work efficiency.

Here are some common sounds placed on the decibel scale:

Sound Quality	Decibels	Sound Source
Threshold of hearing	0 db	Sound proof room
Very faint	10 db	Whisper
		Rustle of leaves
Faint	20 db	Quiet Conversation
		Average auditorium
		Private office
		Quiet home
Moderate	40 db	Quiet radio
		Ordinary conversation
		Average office
		Noisy home
	60 db	
Loud	70 db	Average factory
		Normal radio
		Average traffic
		Noisy office
	80 db	Police whistle
		Pneumatic drill
		Screaming child
Very Loud		Noisy factory
		Loud street noises
	90 db	Pushing power lawnmower
		Wood saw, punch press
	100 db	Subway and elevated train
		Thunder
		Nearby riveter, drop hamme
Deafening	110 db	Boiler factory
		Propeller aircraft
		4 piece rock band
Threshold of Pain	120 db	Turbojet: 7,000 16 Thrust
		Rocket engine

ECOLOGY NAME________________

FILMSTRIP WORKSHEET: ENVIRONMENTAL POLLUTION (WARDS 70W 3800)

#6 POLLUTION CONTROL

1. Why is it more necessary to control pollution today than in the past?

2. Each of the following is a method of controlling air pollution. Explain which type of pollutant is removed by each.
   e.g. auto emission controls - remove carbon monoxide and hydrocarbons.

   A) dust collector
   B) electrostatic precipitator
   C) charcoal adsorption
   D) spray tower
   E) limestone injector

3. How does each of the following deal with solid wastes?

   A) compaction
   B) recycling
   C) anti-litter laws
   D) biocide alternatives

4. Describe the function of each of the following methods of sewage treatment:

   A) septic tank
   B) bar screen
   C) grit chamber
   D) trickling filter (aeration)
   E) several settling tanks
   F) chemical precipitation
   G) chlorination

5. Of the methods listed in question #4 which are part of the primary phase? Secondary phase? Tertiary phase?

6. How effective is primary treatment? Secondary? Tertiary?

7. How can thermal pollution be controlled?

8. How can oil slicks be prevented?

ECO-DECISIONS GAME: SILVER LAKE

Silver Lake is located in a picturesque, coniferous forest in the Adirondacks. It is surrounded by abundant wildlife and the fishing is excellent in Silver Lake and its feeder streams.

The small town of Silver Lake is secluded within this wooded region. A quiet town, it has little construction or development. Its only industry consists of conservative logging activities but it's not considered a booming lumber town. The reported population of 1000 increases only slightly during the summer.

The Ajax Construction Corporation, a New York firm, has submitted to the town board a request to purchase 500 acres of land along the lake. After the town board rezones the area, Ajax Construction Corporation intends to build 200-300 summer homes along the lake shore. See the map of the area.

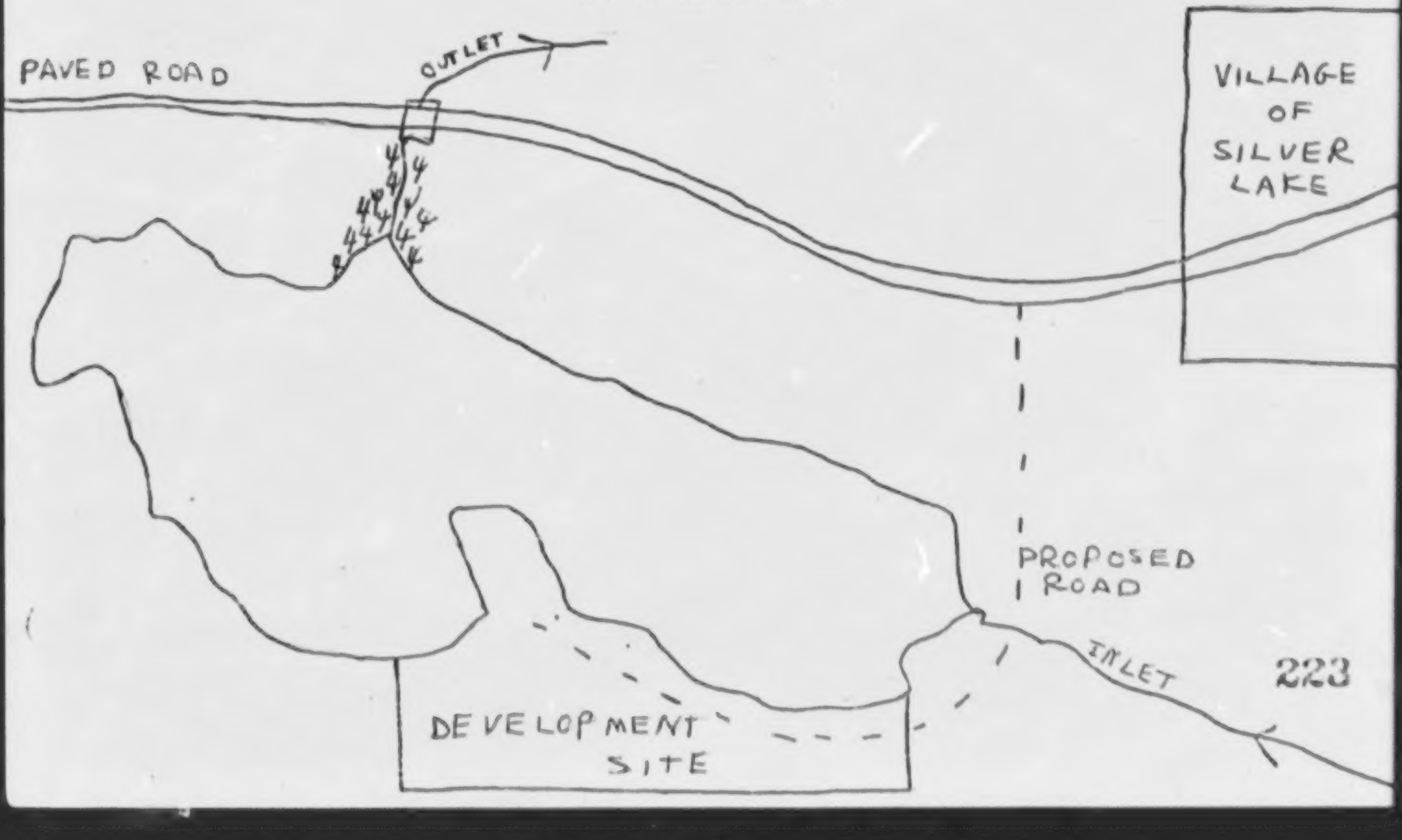
A town board hearing has been scheduled and the following groups will present their positions on the rezoning and subsequent sale of lake property:

Ajax Construction Corporation
Citizen's Committee of Silver Lake
Ecology Interest Groups
Town Board Members

The town board is up for re-election this year and wishes to act in its own best interests as well as those of Silver Lake residents

Step 1: Divide the class into 4 groups.
Step 2: Groups meet to prepare a case for the town board hearing.
Step 3: Town board hears each group's presentation and each presentation is followed by a questioning period.
Step 4: The town board reports its decision and the rationale for it.
Step 5: Town board election and discussion of the results.

MAP OF SILVER LAKE



ECOLOGY GROUPS

YOU REPRESENT: The Sierra Club

Adirondack Mountain Club

Wildlife Federation

Representatives from similar interest groups.

Local hunters and fishermen

Cottage owners already living on the lake

YOUR OBJECTIVE: is to present a strong argument against the town selling this 500 acres to the ajax Construction Corporation for summer home building.

KEEP IN MIND: (1) The effect of the following on the forest and lake environment:

sewage, garbage, litter, camping and hiking, motor boats, snowmobiles, campfires, construction, etc.

(2) The town board is up for re-election this year.

CITIZEN'S COMMITTEE

YOU REPRESENT: Townspeople of Silver Lake a quiet, remote mountain village.

YOUR OBJECTIVE: is to (1) determine how the residents feel about the proposal and (2) present a strong argument at the hearing.

KEEP IN MIND:

(1) If you permit building, local taxes will go down but additional revenue from the developers will permit improvement of schools, roads village park, fire barn, town hall, police.

(2) Summer residents will improve business and there will be patrons for more motels, restaurants, and stores.

(3) Building may damage the ecology of the area. Solid waste and sewage disposal may be a problem. Trees may be cut or damaged. Fish and wildlife may be affected by increased traffic in and around the lake. Silver Lake might lose its serenity. Think of long range impacts on the environment.

(4) The board is up for re-election and you the voters may be able to apply pressure to help your cause.

DEVELOPERS

YOU REPRESENT: Ajax Construction Corporation

2 local realtors

a local private land owner

YOUR OBJECTIVES: are to persuade the town board to:

(1) Rezone sections of Silver Lake

(2) Permit purchase of 500 acres and building of 200 summer homes

(3) Allow resale of developed property

KEEP IN MIND: (1) Opposition groups will frar that no precautions will be taken to preserve the forest and lake ecology.

(2) Local taxes will decrease to the residents but the tax revenue from the developed area will permit a larger budget for the fire department, police protection, sanitation department and water works, maintainence of roads and snow plows, schools, village park.

(3) New residents provide additional business for the town.

(4) You could compromise and buy fewer acres if you face strong opposition.

TOWN BOARD

YOU REPRESENT: Town board members elected by the businessmen and residents of Silver Lake.

YOUR OBJECTIVE: is to listen to all presentations at the town hearing and decide what is best for Silver Lake.

KEEP IN MIND: (1) Rezoning and development would lower taxes to village residents (your constituants) and bring in higher total revenue for tax dependent items such as fire equipment, schools, road repair, snow plows, village park, police protection. But a summer increase of 200-300 families may require better municipal services.

(2) Development could damage the ecology of Silver Lake and draw opposition from special interest groups such as the Adirondack Mountain Club, hunters and fisherman.

(3) You are up for re-election and must please the majority of residents of Lilver Lake whom you represent.

UNIT IV TEST USE ANSWER SHEET

PART I (60 points)

1. Which packaging material is the least biodegradable?
   A) polyethylene plastic C) sawdust
   B) paper D) cardboard

2. The primary stage of water treatment involves mainly the
   A) removal of phosphates C) removal of suspended particles
   B) digestion fo organic materials D) aeration fo water

3. The most ecologically desirable method of refuse disposal is
   A) dumping into the ocean C) using sanitary landfills
   B) using open dumps D) using open incinerators

4. Which of the following contributes least to land pollution?
   A) biocides C) silt
   B) garbage D) organic refuse

5. Which of the following materials is most likely to quickly decompose when buried in the ground?
   A) plastic C) organic refuse
   B) glass D) metal

6. Which term includes the other three?
   A) fungicide C) pesticide
   B) biocide D) herbicide

7. The process of excavating large pits to remove ore is called
   A) sanitary land fill C) shaft minimg
   B) composting D) strip mining

8. Canning factories frequently stack the unusable vegetable parts in an open pile until they decay. This type of disposal is called
   A) composting C) sanitary landfill
   B) reclaiming D) incineration

9. Some used products can be melted or broken down and formed into new products. This process is called
   A) recycling C) reclaimation
   B) reuse D) rendering

10. Which of the following methods of refuse disposal contributes least to health problems
    A) sanitary landfill C) composting
    B) open burning D) ocean dumping

11. A safe method of decreasing the volume of solid wastes is
    A) recycling C) shredding
    B) fission D) incineration

12. Which of the following natural resources is most abundant on the continental U.S.?
    A) gypsum C) aluminum
    B) oil D) nickel

13. Pick the item that is reused more economically than recycled
A) glass bottles
B) tin cans
C) plastic containers
D) cardboard cartons

14. A device for obtaining energy from the sun's radiation is a
A) nuclear reactor
B) turbine
C) breeder reactor
D) solar furnace

15. On a large scale, the most economical and efficient method of obtaining electrical power is
A) waterfall or dam
B) nuclear reaction
C) combustion of coal or oil
D) solar battery

16. An extinct species is the
A) American crocodile
B) buffalo
C) dodo bird
D) wolf

17. A species no longer inhabiting New York State due to heavily collected bounties is the
A) moose
B) puma
C) cayote
D) snowshoe hare

18. Which is not an endangered species?
A) great blue whale
B) grizzly bear
C) whooping crane
D) pririe dog

19. Some species desired for their hide or skin are endangered though they are protected by hunting laws. This illegal taking of an animal is called
A) selective trapping
B) bounty killing
C) poaching
D) biocide

20. The Federal Agency to set standards for air, water, noise and solid waste pollution is
A) Dept. of Agriculture
B) F.D.A.
C) E.P.A.
D) W.H.O.

PART II Do both A & B (20 points each)

A. Choose two of the following pollution problems and discuss:

(1) Sources

(2) Health Hazards

(3) Means of Control

Problems
Solid Wastes

Chemical Wastes

Excess Noise

Landscape Alterations

B. Give an explanation for 5 of the following:

1. Some species are approaching extinction and not by natural causes
2. People working in a noisy factory are irritable and tense.
3. Less paper is recycled today than during World War II.
4. There is a shortage of once abundant oil in the U.S.
5. The E.P.A. banned the use of D.D.T.
6. Residents of a community often vote against bond issues (money) for treatment plants, shredders, etc.
7. President Nixon formed the E.P.A. in 1970.
8. The number of nuclear power plants (for electricity) will shortly double.
9. People working around certain machinery wear ear plugs.
10. The N.Y.S. D.E.C. regulates hinting, fishing and stocking activities in the state.

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(available in Science Department)

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*Andrews (ed.) Freshwater Ecology (F.W.E.). Prentice-Hall, N.J., 1972.

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Palmer. Fieldbook of Natural History. McGraw-Hill, N.Y., 1949.

Hach Chemical Corp. D.R. Colorimeter Manual. 7th ed.

Hach Chemical Corp. Methods Manual for Direct Reading Engineer's Lab (DREL)

Millipore Corp. Experiments in Microbiology. Redford, Mass. 01730

New York State Dept. of Health. Manual of Instruction for Water Treatment Plant Operators.

N.Y.S. Dept. of Env. Cons. Classifications and Standards Governing Waters of N.Y.S.

* texts for course

SUGGESTED READING FOR ECOLOGY COURSE
(Available in E.S.M. Library)

574.92 Arnou B. Homes Beneath the Sea
A study of ocean ecology, very elementary; could serve as a good introduction to marine ecology.

574.5 Bates, Marsten. Forest and the Sea
This work is a bit involved, good, be useful as a reference.

*628 Battan, L. The Unclean Sky Study of air pollution.

574.5 Bonner, J. The Cell and Society
Discusses the interrelationship of all living matter. Focus is mostly on animal life.

*574.5 Boughey, A.S. Man and the Environment
Easy Reading, excellent introduction to ecology. Begins with evolution and dwells in later chapters on basic ecology.

574.5 Chinery, M. Patterns of Living Foundations of Science - Too easy, very elementary. Could however serve as an introduction to ecology.

574.5 Costello, David. The Prairie World
Appears to be very will written, utilizes many illustrations and photographs.

574.5 Darling, Louis. A Place in the Sun
An introduction to ecology, a little less than adequate, could help those having a problem - some good illustrations.

574 Hylander, C. Wildlife Communities
Gives a good overview, very will written with good illustrations and excellent index.

*574.5 Kormandy, Edward. Concepts of Ecology
Excellent. Covers all aspects, gives good illustrations, excellent cross references and index. Could serve as supplementary text.

574.5 Milne, L. Patterns of Survival
A little heavy, poor illustrations.

574.5 Shuttlesworth, Dorothy. Natural Partnerships
Very elementary, could, however, be an excellent introduction to symbiosis.

*574.5 Swater, Paul. Ecology Handbook
Excellent guide to the type of purchases which would benefit the environment.

*Recommended reading for students

*574.5 Taylor, C. The Doomsday Book
Excellent, definitely recommended.

591 Milne, L. The Balance of Nature
An older text which still could be useful.

591.5 Richards, Paul Life of Jungle
Excellent photography.

591.5 Mitchell, J. Ecotactics
Provides ideas and ways on how to influence the government, business and individuals into working for a better environment.

632 Graham, F. Since Silent Spring

*632 Carson, Rachel Silent Spring
The first novel to shock the society about environmental problems.

614 Baron, Robert. The Tyranny of Noise
Good introduction into the problem, causes, and ways to combat noise pollution.

*614 Benarde, Melvin Our Precarious Habitat
Excellent, a fantastic look at what man is doing to his environment.

614 Harber, Lewis Crisis in the City
A little old but still useful in putting across the realization that the problems have become worse.

614 Linton, Ron Terracide
Destruction of her environment. Appears to be very good, achieved much acclaim from Liberal politicians.

614 Long, William Poisons in Food
Discusses the use of chemicals in our food and the possible outcome.

614 Mooney, B. The Hidden Assassins
Excellent account of the harmful additives Americans are ingesting daily.

614 Navarra Our Noisey World
An elementary look at what causes noise.

614 Ridgeway, James Politics of Ecology
Discusses how and where political action must be taken. A must for an intelligent voter.

614 Shurcliff, William SST and the Sonic Boom Handbook
Excellent.

614 Still, Henry The Dirty Animal
Excellent documentary on land, air and water pollution.

614 Wise William Killer Smog
Novel, fictional account on what may (or is) happening to our cities.

***301.2 Toffler, Alvin. Future Shock
Excellent, definitely to be read by everyone in this course.

301.3 Politics and the Environment demonstrates very explicitly the problem confronting us. Appears to be at a very easy reading level.

301.3 Challenge for Survival
Land; air; and water for man in megalopolis. Contains articles from leading authorities on ecological problems. Excellent references.

*301.3 Ehrlich, Paul. Population - Resources - Environment
Excellent. Concerns itself with the problems of a growing population. Very good illustrations and bibliography.

301.3 Falk, Richard. The Endangered Planet
Seems to be a little drawn out, appears to become repetitive.

301.3 Fischer, Tadd. Our Over Crowded Planet
Not too good, may, however, provide some baclground material on population problems.

301.3 Gordon, Mitchell. Sick Cities
A satire which could prove to be very entertaining.

301.3 Helfrich, W. The Environmental Crisis
Short and concise, should make easy reading.

301.3 Ramparts. Eco - Catastrophe
Tells exactly how it feels and places the blame where it belongs.

**301.3 Ehrlich, Paul. The Population Bomb
A must, should be read by everyone.

301.32 Fabre-Luce, Alfred. Men or Insects
A study of population problems.

301.32 Population - Evolution - Birth Control
A collection of essays on these and related topics by some leading authorities. Could provide for quidk reference.

301.32 Tydings, Joseph. Born to Starve
Appears to be very interesting reading.

333.9 Perry, John. Our Polluted World

Helfrich, W. The Environmental Crisis

Lorenz. On Aggression

Barnett. Instinct and Intelligence

Ardrey. Territorial Imperative

Richard. Mystery of Animal Migration

Lapage. Animals Parasitic in Man

Schwartz. Life in a Drop of Pondwater

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The Forest and the Sea. Marston Bates, New York, Random House (Vintage), 1960. ($1.65)

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AIR POLLUTION

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The Unclean Sky. Louis J. Battan. Garden City, Anchor-Doubleday, 1966. ($1.25)

With Every Breath You Take. Howard R. Lewis. Crown Press, 1965.

WATER POLLUTION

The Frail Ocean. Wesley Marx. New York, Ballantine, 1967. ($.95)

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Streams, Lakes and Ponds. Robert E. Coker. New York, Harper & Row, 1954. ($2.95)

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The Wastemakers. Vance Packard. 1960.

PESTICIDES

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Pesticides and the Living Landscape. Robert L. Rudd. Madison, University of Wisconsin Press, 1964. ($1.95).

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Silent Spring. Rachel L. Carson. New York, Fawcett World, 1962. ($.95)

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POPULATION AND FOOD

Famine - 1975! America's Decision: Who Will Survive. W. & P. Paddock. Boston, Little, Brown & Co., 1967. ($2.35).

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Scarcity and Growth: The Economics of Natural Resource Availability. H.J. Barnett and C. Morse. Baltimore, Johns Hopkins Press, 1963. ($2.25).

OTHER

The Chemical Feast. James Turner.

The Closed Corporation. James Ridgeway.

The Corporation Takeover. Andrew Hacker.

Our Depleted Society. Seymour Melman.

The Greening of America. Charles Reich.

Operating Manual for Spaceship Earth. R.B. Fuller.

Whole Earth Catalog.

MAGAZINES

Environment, published ten times yearly, Committee for Environmental Information, 438 N. Skinker Boulevard, St. Louis, Missouri.

Environmental Action, published biweekly, Environmental Action, Inc., 1346 Connecticut Avenue, N.W., Washington, D.C. 20036.

Environmental Activities News Bulletin, Merrill Publishing Co., 1300 Alum Creak Drive, Columbus, Ohio 43216

Environmental Science and Technology, published monthly, American Chemical Society, 1155 Sixteenth Street, N.W., Washington, D.C.

Audubon, published bimonthly, National Audubon Society, 1130 Fifth Avenue, New York, New York.

National Wildlife, published bimonthly, National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, D.C.

The Conservationist, published bimonthly, New York State Conservation Department, Albany.

Catalyst for Environmental Quality, published quarterly, Catalyst for Environmental Quality, P.O. Box 3155, New York, N.Y.

Eco-Action Bulletin, Environmental Action News, 33 E. Minor Street, Emmaus, Penna.

All Clear, published bimonthly, All Clear Publishing, Inc., 299 Forest Avenue, Paramus, New Jersey.

C. F. Newsletter, The Conservation Foundation, 1250 Connecticut Avenue, N.W., Washington, D.C.

Federal Register, E.P.A., Washington, D.C.

National Parks and Conservation Magazine

Natural History, Am. Museum of Natural History, N.Y.

Fauna, Box 895, Rancho Mirage, Calif. 92270 (bimonthly)

Population Bulletin, Population Reference Bureau, 1755 Massachusetts Ave., N.W., Washington, D.C. 20036

Biological Abstracts, 2000 Arch St., Philadelphia, Pa. 19103

FREE FILMS FROM: B.O.C.E.S.
Ward Kimball-A.V. Director
Call 468-4645

Animal War - Animal Peace - 30 min.

The Spruce Bog - 23 min.

World in a Marsh - 22 min.

FREE FILM FROM: Shell Oil Corporation
450 Meridian St.
Indianapolis, Ind. 45204

The River Must Live - 30 min.

FREE FILMS FROM: N.Y.S. School of Environmental Science and Forestry
Mrs. Stella Kroft, Film Librarian
Syracuse, N.Y. 13210

Ah, Man See What You've Done - 20 min.

Boomsville - 10 min.

Cave Community - 13 min.

Down Decibel Down - 11 min.

High Arctic Biome - 22 min.

Multiply and Subdue the Earth - 67 min.

Pollution A Matter of Choice - 52 min.

Population Ecology - 21 min.

Realities of Recycling - 38 min.

Stuff We Throw Away - 22 min.

What on Earth? - 10 min.

FREE FILM FROM: Millipore Corporation
Bedford, Mass. 01730

Membrane Microfiltration

FREE FILMS FROM: National Medical Audiovisual Center
Station K
Atlanta, Georgia 30324

M-1739/16	Don't Leave It All To The Experts	16 min.
M-1707	Beware The Wind	22
M-1774	The Run Around	11
M-1712	On A Clear Day You Can Almost See Terminal Tower	22
M-1418	The Poisoned Air	50
M-1419	Air of Disaster	50
M-1430	With Each Breath	30
MIS-984	Ill Winds On A Sunny Day	28
M-1420	This Business of Air	30
M-1431	It's The Only Air We've Got	25
M-1530	A Matter of Attitudes	30
M-1540	Air Pollution: Take A Deep Deadly Breath	54
M-1600	A Day At The Dump	15
M-1624	Air Pollution in New York-New Jersey Area	15

FILMS FROM: Syracuse University*
Film Library
Colvin St.
Syracuse, N.Y.

Community - 11 min. - $4.25

Garbage Explosion - 16 min. - $10.00

House of Man - 56 min. - $17.00

Lakes, Aging and Pollution - 15 min. - $10.00

Noise is Pollution Too - 15 min. - $9.00

Plant and Animal Communities: Changes in the Balance of Nature - 11 min. - $6.50

Plant and Animal Communities: Interrelationships - 14 min. - $8.00

Plant and Animal Communities: Ecological Succession - 14 min. - $7.00

Plant and Animal Communities: Physical Environment - 11 min. - $6.50

Ward's Filmstrips For Science (70W3800)

1. Nature of the Crisis - a little elementary; it is, however, very ordered and gives an overview of the factors involved in producing environmental pollution could be used as an introduction or set up for student use.

2. Air Pollution - Excellent - you may, however, want to check some of the statistical data being used.

3. Land Pollution - very orderly; could serve as a good introduction.

4. Fresh Water Pollution - excellent

5. Marine Pollution - excellent

6. Pollution Control - gives detailed scope of problems and solutions. Good on sewage treatment.

OTHER FILMSTRIPS

Animal Communication

Air Pollution

Ecology of North American Deserts

Symbiosis

Biological Societies

Animal Navigation

Biological Clocks

The Canopy of Air

Combatting Insect Pests

Commitment

ADDITIONAL SOURCES OF INFORMATION

1. U.S. Environmental Protection Agency, Office of Public Affairs, Washington, D.C. 20460
2. New York State Department of Health, H. Ingraham, Commissioner, Albany, N.Y.
3. New York State Department of Environmental Conservation, H. Diamond, Commissioner (NYSDEC), Albany, N.Y. 12201. Information Leaflets.
4. American Public Health Association (ALPHA), 1015 18th St, N.W., Washington, D.C. 20036
5. Environmental Protection Agency (E.P.A.)
6. U.S. Department of Agriculture
7. U.S. Department H.E.W.

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

8. Regional Environmental Sanitation Testing Lab (N.Y.S.) 677 S. Salina St., Syracuse, N.Y. 474-5951
9. Pollution Dynamics Corporation, Rochester, N.Y.

EAST SYRACUSE-MINOA SCHOOLS

Environmental Education Materials

High School Package

Environmental Biology Unit

Produced Under USOE Grant OEG-0-71-4621
by East Syracuse-Minoa Central Schools
407 Fremont Road
East Syracuse, N.Y. 13057
Dr. Fritz Hess, Superintendent

ECOLOGY

A Three Week Unit for Regents Biology

East Syracuse-Minoa Central High School 1973

AUTHORS:

Joseph McGrath

Donald Parker

Mary Pinkerton

WORKSHEET	OBJECTIVES	TIME	RESOURCES *
1. Introduction	1, 2, 3, 4, 7, 8 (outline I)	1 period 1 homework assignment.	1. Blue - Chap. 27. 2. Green - Chap. 2. 3. Yellow - Chap. 36, pp.677-684. 4. *Concepts* - p.375-380, 385-388. 5. Text - pp.536-7, 544-5. 6. Film: *Population Ecology* 7. Quiz - A & B 8. Erlich, Paul, *Population Bomb.* 9. *Patterns & Processes* pp.21-23. 10. I.I.S. pp.265-8. 11. *E.S.A. Booklet*: "Study of Population Fluxuation in a Microcommunity." "Population Change"
2. Populations	3, 4, 5, 6 (outline II)	3-4 periods 2 homework assignments.	
3. Food Webs (Niches & Symbioses) Introduce #4 first	9, 16 (outline III & IV, A-B)	2-3 periods 2 homework assignments	1. Blue - pp.728-730. 2. Green - pp.28-30, 83-88. 3. Yellow - pp.695-700. 4. *Concepts* pp.381-385. 5. Text pp.540-543. 6. Quiz: x+y 7. Films: *Communities, Plant & Animal Interactions, Strange Partners.* 8. *E.S.A. Booklet*: "Symbiosis," Galls, Parasites.
4. Quadrat Study	9, 10, 11, 13, 14, 15, 16.	3 periods outside, 1 period in lab, 1 homework assignment.	1. Green - pp.72-82. 2. Yellow Lab Book pp.218-231. 3. Andrews, *Freshwater Ecology.* 4. Huch test kits & instruction booklet. 5. I.I.S. pp.47-52, 249-254. 6. Stock, *Investigations in Modern Biology* pp.26-31, 182, 192. 7. E.S.A. Booklet: "Layering", "Classification". 8. Identification books from library (see bibliography) 9. Palmer, *Fieldbook of Natural History.*

*See bibliography for complete information

WORKSHEET	OBJECTIVES	TIME	RESOURCES
5. Succession	13, 14, 15 (outline IV.E.)	2 periods 2 homework assignments	1. Blue - pp.736-7, 732-4. 2. Green - pp.92-3. 3. Yellow - pp.218-221, 701-703. 4. Concepts - pp.391-393. 5. Text - pp.546, 551. 6. E.S.A. Booklet: "Layering Packet" "Biological Succession" "Succession in a Freshwater Ecosystem". 7. Film: Succession: From Sand Dune to Forest. 8. Filmstrip: Checks & Balances. #4 Succession (Modern Learning Aids 6410) 9. Weinberg, Biology Lab Manual pp.225 + 10. I.I.S. pp.269-72. 11. Quiz: M.
6. Recycling in Nature	16-23 (outline IV. C-D).	2 periods 2 homework assignments	1. Blue - pp.735-6. 2. Green - pp.18-27. 3. Yellow - pp.686-697. 4. Concepts - pp.388-390. 5. Text - pp.538-9. 6. Quiz: D.

WORKSHEET	OBJECTIVES	TIME	RESOURCES
7. Biomes	24 (outline V.)	1-2 periods 1-2 assignments	1. Blue - pp.722-3. 2. Green - pp.250-337 (Chap. 8 & 9). 3. Yellow - Chap.37. 4. Concepts - pp.393-9. 5. Text - pp.547-51. 6. Films: Temperate Deciduous Forest, Tropical Rain Forest, Desert, High Arctic Biome. 7. Quiz: Q.
8. Environmental Pollution: Nature of the Crisis.	25, 26, 27 (outline VI.)	1 period 2 assignments	1. Blue - pp.740-4. 2. Green - Ch.20, pp.745-771. 3. Yellow - pp.734-755 (Chap.38.) 4. Concepts - pp.399-407. 5. Text - pp.606-610. 6. Film: Pollution is a Matter of Choice. 7. Andrews, Environmental Pollution. 8. Filmstrip: Nature of the Crisis (Wards 70W 3800 #1) 9. Record Album: Seeger, Pete. "My Dirty Stream." Fall River Music Inc., 1964.
9. Thermal Effects on an Aquatic Ecosystem (optional)	25, 26, 27. (outline VI)	1-2 periods 1 assignment	1. Andrews, Freshwater Ecology. pp.19-22, 28, 100, 154. "Suprise Quiz"
Unit Test			

OPTIONAL ACTIVITIES:

B.S.C.S., Green Version: High School Biology.

Lab 1.5 "Interelationships of Producers and Consumers" p.26. (snail & elodea).

Lab 2.1 "Population Growth: A Model" p.43 (dry lab on House Sparrow).

Lab 2.2 "Yeast Population" p.53 (similar to one included)

Lab 2.3 "Population Changes in Open Systems" p.61 (graphing, dry lab, mouse & pheasant)

Lab 3.1 "A Study of a Biotic Community" p.76. (a quad study)---a good project

Lab 3.2 "Abiotic Environment" p.98 (weather conditions)

Lab 8.2 "Temperature, Rain And Biome Distribution" p.282 (dry lab)

Lab 8.3 "Effects of Fires on Biomes" p.296 (dry lab on succession)

Lab 9.1 "Succession in a Freshwater Ecosystem" p.312

Lab 15.2 "Behavior of an Invertebrate Animal" p.554. (sow bug response to light and a maze)--- a good project.

Lab 15.3 "A Method for Studying Territorialism" p.561 (Birds---a dry lab)

B.S.C.S., Blue Version: Molecules to Man

Inv. 27.2 "Investigating the Sampling of Populations" p.680 (yeast & dandelion)

B.S.C.S., Yellow Version Lab Manual: An Inquiry Into Life

Lab 36.1 "Biological Succession---Part A" p.218 (a good project).

Lab 37.1 "Producers in an Ecosystem" p.222.

Lab 37.2 "Consumers in an Ecosystem" p.227.

Weinberg, S. Biology Lab Manual:

Lab 67 "Microaquarium" p.223. (snails, worms, daphnia, protozoa, & algae).

Lab 68 "Succession" p.225 (pond water & microscope)

Lab 69 "Soil Organisms" p.227.

Stock and Bancheri, Investigations in Modern Biology:

Lab 10 "Classification of Plants" p.26

Lab 11 "Classification of Animals" P.29 (How to use a taxonomic key, describes major groups)

Lab 71 "Testing the Environment for Bacteria" p.201. (also in E.S.A. Booklet)

Environmental Studies Area Booklet (for E.S.M. H.S. Campus)

"What Can We Learn from a Field Study?"

"A Survey of A Biotic Community"

"Patterns of Life in the Water"

"Succession in a Freshwater Ecosystem"

"Study of Population Fluctuations in a Microcommunity"

"The Goldenrod Forest"

"Study of Insect Galls"

"Producers in a Community"

"Air Analysis Packet"

"Wildlife Conservation"

"Collection of Wood"

"Budding and Grafting"

"Forestry Packet"

PROJECT SUGGESTIONS:

1. Check the E.S.A. Booklet and 12th Grade Ecology Curriculum.
2. Drosophilia population and limiting factors in a test tube.
3. Algae population (chlorella) and temperature.
4. Daphnia and varying D.O. (dissolved oxygen).
5. Duckweed and varying phosphate concentration.
6. Crayfish and crowding (or frogs).
7. D.O. and temperature of a stream.
8. Pollution and Butternut Creek.
9. A quad study comparing all seasons.
10. Territorialism in birds.
11. Rotten log community.

REFERENCES: FILMSTRIPS

"Environmental Pollution: Nature of the Crisis" (Wards 70W 3800 #1) (others in this series are also excellent and used in ecology)

"Checks and Balances: Succession (#4)" (Modern Learning Aids 6410) (most of the others in this series are too elementary)

LAB REPORT FORMAT

Name Date

Lab # Period

Lab Title

1. Purpose: Why are you performing this investigation? What is your objective?

2. Prediction: What are your expected results? You may just have to guess---but make it a logical one.

3. Procedure: This will usually be on a ditto or in a lab book and you can refer to it by page number. However if this is an original lab, you must list all steps you followed.

4. Data: Your results and observations may be presented as charts, tables, graphs, photographs, drawings, or descriptions.

5. Discussion: Usually you will be assigned questions from a ditto or lab book which will help you interpret the data, formulate hypotheses and become aware of limitations of data or sources of error. For original labs you will have to refer to books to interpret the results.

6. Conclusion: Make a concluding statement (hypothesis) explaining your results. Confirm or reject your prediction. Be original, creative and logical in your concluding statement.

7. References: List all books, films, people or other resources to which you referred to answer questions, form hypotheses or interpret data.

ECOIOGY OUTLINE: CHAPER 27

I. BIOLOGY

- A. Abiotic factors
- B. Biotic factors
- C. Organization

II. POPULATIONS

- A. Characteristics
- B. Balance of nature
- C. Societies

III. COMMUNITIES

- A. Food dependency
  1. autotrophs
  2. herbivores
  3. carnivores
  4. omnivores
  5. saprophytes
- B. Symbiosis
  1. commensalism
  2. mutaulism
  3. parasitism

IV. ECOSYSTEMS

- A. Biotic competition
- B. Food web
  1. habitat vs. niche
  2. producers
  3. consumers (primary and secondary)
  4. decomposers
  5. flow of energy
- C. Abiotic factors
  1. nitrogen cycle
  2. carbon dioxide - oxygen cycle
  3. water cycle
- D. Self substaining ecosystem
- E. Succession

V. BIOMES

A. Terrestrial

1. tundra
2. taiga
3. temperature deciduous
4. tropical forest
5. grassland
6. desert

B. Aquatic

1. marine
2. fresh water

VI. BIOSPHERE

A. Human ecology

1. population explosion
2. pollution (air, water and land)
3. natural resource waste
4. pesticides
5. wildlife extinction
6. chemical overuse and resistance

ECOLOGY UNIT IN BIOLOGY

Terminal Behavioral Objectives

The student will be able to

1. When give a list of conditions, identify those that are biotic from those that are abiotic.
2. Place each organizational level in its proper sequence if given a jumbled list. i.e. population - community - ecosystem - biosphere.
3. Define a population as all the organisms of one species living in a definate area.
4. List the factors that affect population size and stability.
5. Plot a growth curve from data collected on yeast population.
6. Formulate reasons to explain increases and decreases in yeast population.
7. Define a community as all the biotic living things of any species interacting in a definate area.
8. Distinguish community from an ecosystem.
9. Identify feeding niches, (i.e. producer, herbivore, carnivore and other consumers, and decomposers) and symbiosis, (i.e. parasite, commensalite, mutualite).
10. Use a taxonomic key to identify organisms at least to genus level.
11. Use Hach methods to determine dissolved oxygen samples of water at different temperatures and submit an interpretation of the over all class results.
12. Make observations of microbes from soil and water samples, sketch them, identify them and determine interrelationships i.e. food web.
13. Read and discuss lab 29.8 in Molecules to Man and determine the changes in the food web of Lake Odell over a period of time.
14. Describe the stages of succession as it occured in the film: Sanddune to Forest.
15. Give evidences of succession in your quad.
16. Construct a food web from observations made at quad along Butternut Creek.

17. List the forms in which the following elements may be found in the environment and organisms: C, H, O, N, P.

18. Identify the role played by each of the following in the water cycle: precipitation, root absorption, transpiration, respiration, photosynthesis, evaporation.

19. Identify the role played by each of the following in the $CO_2 - O_2$ cycle: photosynthesis, respiration, autogrophs, decomposers, aerobes.

20. Match each of the following with its role in the Nitrogen Cycle: legumes, nitrogen-fixing bacteria, nitrates in soil, nitrogenous, plants and animal protein, plant and animal wastes (ammonia), nitrifying bacteria, decay, denitrifying bacteria.

21. Trace the flow of energy from the sun through all organisms in the food web to the environment.

22. Recognize examples of ways in which man has upset these natural cycles.

23. Distinguish recycling and reuse.

24. Identify biomes when given a description that includes its characteristic vegetation and climate.

25. List examples of environmental mismanagement and pollution.

26. Give the causes of specific types of pollution or environmental mismanagement.

27. Suggest practical solutions to specific pollution problems.

ECOLOGY
INTRODUCTION

WORKSHEET #1

ECO (house) - LOGY (study of) study of living communities and their physical environment

BIOTIC - living factors

ABIOTIC - non-living factors

LEVELS OF ORGANIZATION

POPULATIONS	Study of one species in a definite area eg. man, ameba, maple
SOCIETY	Study of a highly organized species working together eg. baboon, bees
COMMUNITIES	Study of all the living species in an area and their interactions eg. all species in Oneida Lake
ECOSYSTEMS	The interactions of all living things with their physical environment (biotia & abiota)
BIOSPHERE	The entire world, all ecosystems collectively

Read pp. 535 - 537 in (Weinberg) (is keyed as "test" in Reference list to be in appendix) or pp. 375-380 in Concepts in Modern Biology

IDENTIFY THE LEVEL FOR EACH OF THE FOLLOWING:

1. all the white clover in the school lawn
2. all the people in the world
3. all the palm trees and monkeys in Panama
4. all the ants in a hill
5. all the rainbow trout in Fourth Lake
6. all the fish, oxygen and pollutants in Onondaga Lake
7. all plants and animals in this planet
8. all lynx in the Rocky Mts. and the fleas on them
9. all hawks and the pesticides in their tissues
10. a tropical rain forest, its flora, fauna and climate

11. List 6 abiotic factors affecting a land community and state the important of each.

12. List 6 biotic factors affecting a pond community and state the importance of each.

13. List in order the spectum of organization from atoms to biosphere.*

A population is all the organisms of one species inhabiting an area with a given boundary. Species is defined as an interbreeding unit. eg. all the red pines of the Adirondacks, all the cobras in San Diego Zoo.

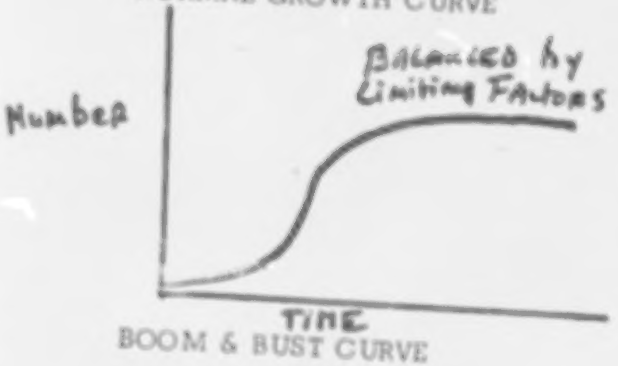
Limiting Factors are conditions or quantities of essential materials that determine the size of a population.

Carrying Capacity - (K) - is the maxium number of organisms in a community and is determined by the limiting factors.

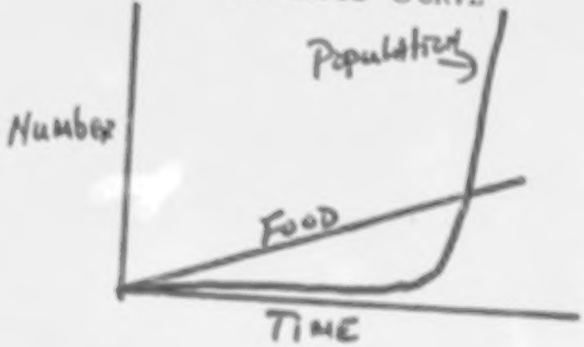
List some factors that would limit population size in general.

FLUCTUATION Populations are constantly changing as result of interactions with other organisms and the physcial environment but do to natural checks and balances (predatorprey, relationships, available food and space) they tend to remain stable. However, when the natural checks and balances are removed, characteristic growth curves are exhibited.

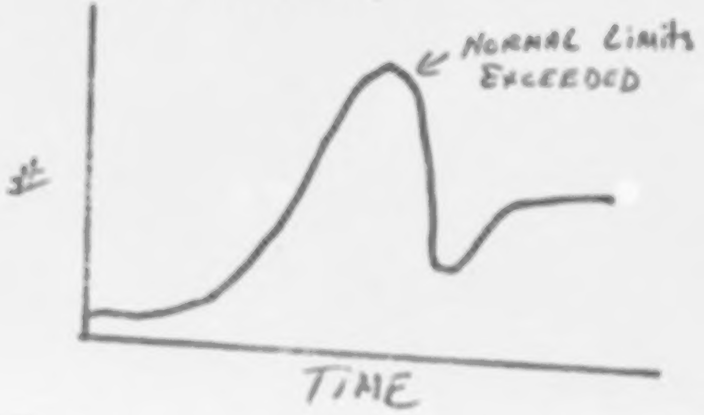
NORMAL GROWTH CURVE



MALTHUS' CURVE



BOOM & BUST CURVE



FORM A

ECOLOGY QUIZ NAME ____________________

1 - 7 Tell whether these are Abiotic (A) or Biotic (B) factors:

________ 1. pH

________ 2. parasite

________ 3. predator

________ 4. temperature

________ 5. soil type

________ 6. over population

________ 7. water pollution

8 - 10 Matching:

________ 8.	All the rats of one species in New York City	A. population
________ 9.	All the plants, animals & their physical environment of a tropical rain forest	B. community
________ 10.	All living plant , animal , protist organisms in Oneida Lake.	C. ecosystem

FORM B

ECOLOGY QUIZ NAME ____________________

1 - 3 Matching

_______ 1. All the carp of the same species of Onondaga Lake.

_______ 2. All plants, animals and protists in Cicero Swamp.

_______ 3. All living things and physical environment of a desert.

A. ecosystem

B. community

C. population

4 - 10 Tell whether these are Abiotic (A) or Biotic (B) factors.

_______ 4. air pollution

_______ 5. hawk eating a snake

_______ 6. water temperature of a lake

_______ 7. soil or rock surfact

_______ 8. oxygen

_______ 9. tapeworm living in a dog

_______10. green plant

LAB WORKSHEET #2: CHAPTER 27 POPULATIONS

Read pp. 544 - 545 in your text (Weinberg)

1. Define population

2. Predict some factors that might limit the size of a population.

3. Set up the yeast population lab attached, and record results in data table.

   IMPORTANT: Use the same miscroscope everday, record its number.
   Graph results.

4. Summarize the changes you noticed in the yeast population. Explain all increases and decreases in terms of limiting factors.

5. Explain Malthus' theory on population.

6. List some ways populations are naturally controlled and kept in balance.

7. What conditions might increase the carrying capacity of a pond for algae?

8. How would a bounty on wolves affect:

   rabbit population?

   vegetation?

   mouse population?

EXTRA CREDIT - Read the Population Bomb by Paul Erlich. It is in our library. Write a report sumarizing his main points.

Investigating Changes in a Yeast Population

Yeast is a one-celled protist in the fungi group. It reproduces by budding. What are some factors you predict will limit the yeast population size in a test tube?

Procedure (1) From a package of dry yeast, take about 15 granules and place them in a 250 ml beaker containing 30 ml. sterile water. Stir until they are evenly distributed.

(2) Examine a drop of the suspension under (100x) low power. There will probably be too many yeast to count.

(3) Dilute the yeast solution by adding 10 ml water and examine another drop. Continue diluting with 10 ml of water until just a few cells can be seen under 100x low power. Record the total amount of water added. ________ ml.

(4) Add enough sugar to make a 5% sugar solution. Example: 5g sugar in 100 ml or 2.5 g in 50 ml H_2O.

(5) Divde sugar-yeast culture equally among 10 test tubes. Number them from 1 - 10 and insert cotton plugs.

(6) Take a drop of test tube one. Examine it under 100x and count the number of yeast cells* Do this three times and record the average in your data table. Tomorrow you will sample test tube 2, etc.

(7) Store the test tubes at room temperature. On each successive day record the average number of yeast per drop. Stir thoroughly before making the slides.

DATA

Count	Day 1 Tube 1	Day 2 Tube 2	Day 3 Tube 3	Day 4 Tube 4	Day 5 Tube 5	Day 6 Tube 6	Day 7 Tube 7	Day 8 Tube 8	Day 9 Tube 9	Day 10 Tube 10
1st										
2nd										
3rd										
Average										

---

* If you can't see them use high power and multiply the number by 4.0 or 4.3 depending on the low:high ratio of your microscope.

Plot your results on a graph with the number of yeast on the vertical axis and the day on the horizontal axis.

Materials for yeast study

dry yeast
sugar
10 test tubes per group
test tube racks
sterile water (use pressure cooker)
250 ml beakers
graduated cylinders or 10 ml pippettes
eye droppers
microscope, slides, cover slips
triple beam balances
foil or cotton plugs

POPULATION LAB FORMAT

PURPOSE			5 pts.
PREDICTION			5 pts.
I.	Yeast		
	Data Table	3	20 pts.
	Graph	5	
	Ditto Quest. #1 - 6	3 each	
II.	Human		
	Graph	5	20 pts.
	p. 688 quest. #1 - 6	2 1/2 each	
CONCLUSION			
	Summarize the two studies		10 pts.

ECOLOGY WORKSHEET #3 NAME ____________________

FOOD WEBS

Refer to Molecules to Man (blue) pp. 728 - 730, or Inquiry into Life (yellow) pp. 695 - 700, and your text pp. 540 - 543. Also view the film: Communities.

1. All organisms have a role in the food web. This role is called a niche. No more than one species may occupy a niche in a community. Define the following niches:

   producer

   herbivore

   carnivore

   omnivore

   decomposer

2. Which of the above could be a primary (1st order) consumer? ____________

   Which could be a secondary (2nd order) consumer? ____________________

   Which could be a 10th order consumer? ______________________________

3. a) What is the difference between a prodator, scavenger and parasite?

   b) What is the similarity?

4. Some organisms exsist in a close relationship with another species. This is called a symbiosis.

   a) View the film: Strange Partners

   b) Define the nature of the following symbiotic relationships:

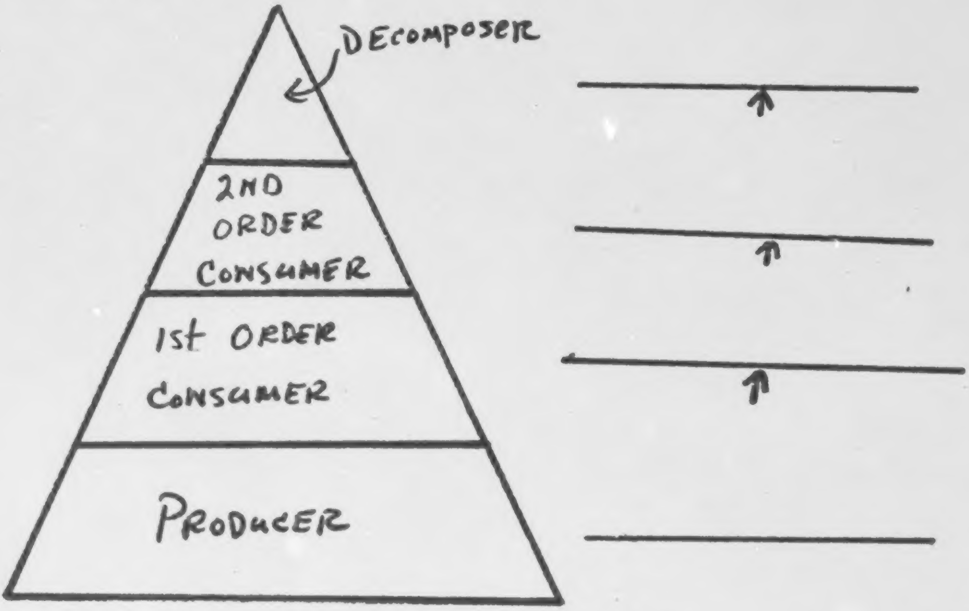
   parasitism

   commensalism

   mutualism

ECOLOGY WORKSHEET #3

5. Complete this food web pyramid by adding names of organisms that might exist at each level.


DECOMPOSER
2ND ORDER CONSUMER
1st ORDER CONSUMER
PRODUCER

6. Which organisms in this food web would have the greatest amount of energy? ____________________ Least? ____________________

7. Which organisms must be present in the greatest amount of biomass?

____

8. MATCHING:

_____ shark & remora
_____ tapeworm
_____ lichen (algae & fungus)
_____ disease bacteria
_____ crockadile & bird
_____ nitrogen-fixing bacteria & legume root
_____ barnacle and whale
_____ leech
_____ termite protozoan

M - Mutualism
P - Parasitism
C - Commensalism

ECOLOGY WORKSHEET #3

9. Huxley once said that he could predict the number of old maids in a town by observing the yellow clover on the outskirts. He explained it thusly: Old maids usually had cats that chased toads. Toads eat insects and insects and insects eat or pollinate clover. Therefore, if there are many old maids in a village, would the clover crop be prosperous or scant? ________________
Explain:

FORM X

ECOLOGY QUIZ
FOOD WEB

NAME ______________________

MATCHING

_______ 1. Cat eating a mouse

_______ 2. Deer nibbling on tree buds

_______ 3. Bacteria decaying dead leaves

_______ 4. lichen on bark

_______ 5. dog eating table scraps: meat & vegetables

_______ 6. fungus on a rotten log

_______ 7. mosquito biting a man (or woman)

_______ 8. algae photosynthesizing

_______ 9. beaver gnawing on a tree

_____10. wolf hunting pheasants

NICHE:

J. omnivore

K. carnivore

L. herbivore

M. scavenger

N. saprophte

X. parasite

Y. mutualite

Z. autotroph

FORM Y

ECOLOGY QUIZ
FOOD WEB

NAME ____________________

MATCHING

______ 1. Mouse gnawing wood
______ 2. Plant synthesizing glucose
______ 3. Hawk hunting for snakes
______ 4. Tapeworm in a dog
______ 5. Mushroom digesting rotten leaves
______ 6. Man eating a five course meal
______ 7. Lichen on a rock
______ 8. Beetle eating dead bark
______ 9. Rabbit nibbling on a carrot
_____ 10. Lion devouring a deer carcass

NICHE:

A. parasite
B. saprophyte
C. carnivore
D. herbivore
E. autotroph
F. mutualite
G. omnivore
H. commensalite

QUADRAT STUDY INTRODUCTION

BIOLOGY LAB #4

The next two weeks of school we will be undertaking some ecological studies of the ES-M area. For example:

1) Plot study
   Students in groups of five will be marking off 100 sq. m. of land on the far side of the student parking lot. Longitudinal observation on soil (pH), biota (species of plant and animal), and any other observations will be made and analyzed over the next two months.

2) General Ecosystem Study
   At least three types of ecosystems exist on the school property; swamp, pond, stream. Determination of food chain, symbiosis, etc. within each will be made.

3) Environmental Pollution
   Soil, air, and water pollution will be studied on the ES-M area.

4) Clutter Pollution
   On trips to the area, students will be supplied with bags for picking up litter on the grounds. Gratuities (brownie points) will be awarded for winners (weekly) in the following catagories:
   - Most Original
   - Most Humorous
   - Best Decorated
   - Largest Amount

   Individual winnters will be selected from nominees (one from each class) and in lecture will be presented with the coveted CLOD award. (Collected Lots of Debris) At the termination of the eight week study, grand prize winners will be honored with the Schaffer award, a golden beer can representing the millions of cans over this land.

This may be an opportunity for some to complete their individual year projects. Expansions of the planned studies could be acceptable for the year project.

Also those who are planning a photographic project might find this could be a good place to start.

MATERIALS FOR QUADRAT LABS

SET UP

wooden stakes (16)
string
hammers (4)
meter sticks (4)

WATER

jars
Hach kits (D.O.)
soup strainers
thermometers (cheap)
boots (optional)

LABANALYSIS

microscopes and slides
eye droppers
pH papers and charts
Hach kits - (CO_2, pH, D.O., hardness, et.al)
poloroid camera (optional)
identification keys
Berlese funnel and lamp
incubator (optional)
millipore kit (optional)

SOIL

plastic baggies
trowels (4)
pH paper

FLORA AND FAUNA

pill bottles
insect nets - make from hanger and nylon net
identification books
plant press (optional)
binoculars (optional)
mouse traps (optional)
fishing line (optional)

ECOLOGY
BIOLOGY LAB #4

QUADRAT STUDY

I. Make a 100 sqm area to study (10 meters on a side). Place a stake at each corner and connect with string to form a square. This is the area we will study.

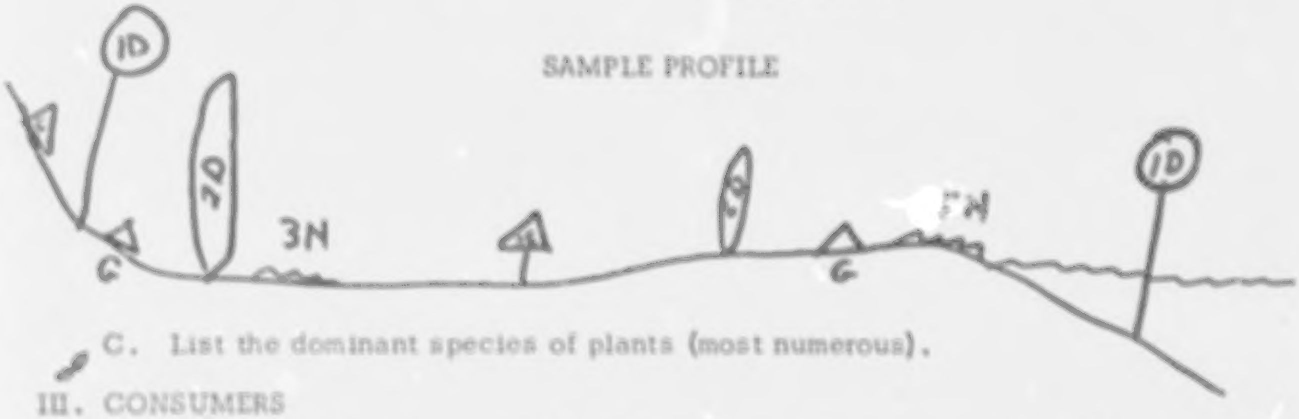
II. SITE PROFILE OF PRODUCERS

A. Count and identify:
   1. trees - count, name and give the height of each tree
   2. shrubs and saplings - these are smaller woody plants, 0.5-3.0m. tall
   3. herbaceous plants - weeds and grasses, count several 1 sqm. fungi.

B. Use the following symbols, indicate the number of each type of plant, and draw a profile of this quadrat.

♀	Canopy - trees over 20m	Woody:
▲	Subcanopy- trees under 20m	deciduous D
⬮	Shrubs- woody	evergreen E
△	Herbs	Herbaceous:
~	Litter	grass G
		non-grass N

SAMPLE PROFILE



C. List the dominant species of plants (most numerous).

III. CONSUMERS

A. Protists - Take a sample of soil from two places and put into a plastic bag. When you return to the lab place soil in a cloth strainer and identify the mircoscopic organisms that drip out of the soil water.

B. Invertebrates - collect small surface animals under rocks and leaves, preserve and identify. (insects, worms, etc.)

C. Vertebrates - Look for birds, small mammals, amphibians and reptiles, or traces of them.

IV. ABIOTIC FACTOS

A. soil type - sand, clay, humus

B. temperature variation - every hour at surface

C. soil pH - acid or base

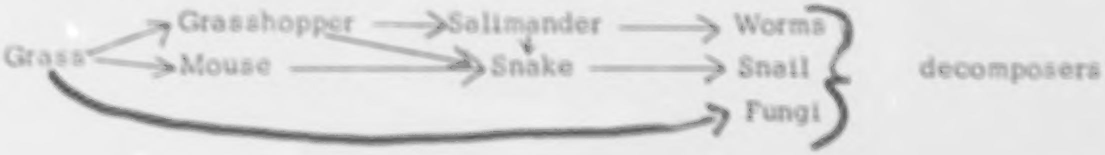
D. amount of sunlight or shade

E. water analyses

F. others - you list

V. FOOD WEB - List which organisms are producers, herbivores, carnivores, decomposers, omnivores. Diagram a food web of this community.

Sample


Grass
Grasshopper
Mouse
Salimander
Snake
Worms
Snail
Fungi
decomposers

QUADRAT DATA

I. LOCATION OF PLOT - Include map or photograph

Size -

Type ecosystem -

Available niches -

II. PRODUCERS - Include drawing of profile

Trees -

Herbs & Weeds -

Floor Covering -

Algae - (sketch, name and give size in microns)

Is there evidence of ecological succession?

III. CONSUMERS

Protists - sketch, name and give size in microns

Invertebrates -

Vertebrates -

IV. ABIOTIC FACTORS - list

V. FOOD WEB:

Producers

1st order consumers

2nd - 3rd order consumers

decomposers

symbiotic relationships

Sketch one aquatic (water) food web and one terrestrial (land) food web.

VI. List indirect evidences of life (tracks, burrows, excrement, feathers, nests, etc.).

VII. List evidences of pollution (water, air, clutter, land).

BIOLOGY WORKSHEET #5 NAME ______________________
SUCCESSION

First view the film: Succession: From Sand Dune to Forest

Succession is a series of growth stages in which one community replaces another until a climax community is reached. The climax community is stable and remains until there is a drastic disturbance, ex. flood, earthquake, fire. Refer to pp. 546 & 551 in your text.

1. If a wooded area in the Adirondacks was wiped out by a forest fire, what pioneer plants would first grow back?

2. After many years of gradual change, a climax forest would be developed. List some trees and animals that could be found in this forest.

3. What trees are dominant in a climax forest in Central New York?

4. Refer to pp. 701 - 703 in Yellow Version and summarize the steps in succession from a sand dune to a forest by listing the plants of each stage and the animals associated with them.

5. Read 29.1 - 29.8 (Lake Odell) in Molecules to Man and answer question 1 - 13 on p. 732.

QUIZ: SUCCESSION

FORM M

NAME ______________________________

____1) After a bulldozer has knocked down a house and created a vacant lot, various kinds of plants appear. As the years pass there is a noticeable change in the species of plants inhabiting the lot. This is an example of

a) a food web
b) succession
c) plant maintenance
d) symbiosis

____2) It would be most accurate to say that the climax stage of a plant succession

a) changes rapidly to the pioneer stage
b) does not require a producer community
c) remains permanently unchanged
d) exhibits a tendency to remain stable

____3) The earliest stage in an ecological succession from a bare rock is characterized by the presence of

a) trees
b) mosses
c) lichens
d) grasses

4 - 10 Refer to the following food web of Lake Odell.

Mackinaw trout & Osprey → White Fish & Rainbow → Chubs → Insect Larvae → Swamp Weeds & Algae

How would each of the following affect the whitefish population?

(A) Increase (B) Decrease

____4) Removal of chubs to please fishermen.

____5) Stocking the lake with Mackinaw trout to improve fishing.

____6) Campers spraying excessively along the shore with DDT or other pesticides.

____7) Extinction of osprey.

____8) Decrease of D.O. (oxygen) by overuse of an algae killer.

____9) Elimination of the first order consumer.

____10) Population explosion of second order consumer.

ECOLOGY WORKSHEET #6 NAME ______________________________

RECYCLING IN NATURE

All the elements essential to life (C, H, O, N) are recycled through organisms, the environment and chemical processes. Refer to pp. 735 - 6 in Molecules to Man pp. 686 - 691 in Inquiry Into Life (yellow) (or pp. 538 - 539 in your text) to answer these questions.

1. Water Cycle - Sketch the water cycle & define the role played by:

   precipitation -

   root absorption -

   transpiration -

   respiration -

   photosynthesis -

   evaporation -

2. How does pollution (air & water) affect the water cycle?

3. Oxygen Cycle - Sketch the carbon dioxide - oxygen cycle and define the role played by:

   autotrophs -

   bacteria of decay -

   aerobes -

   photosynthesis -

   respiration -

4. How does air pollution, such as carbon monoxide, &sulfur dioxide from auto exhaust, affect the oxygen cycle?

5. What gas composes 78% on the air? ______________________________

6. Nitrogen Cycle - Sketch the nitrogen cycle and define the role played by:

legumes -

nitrogen-fixing bacteria -

nitrifying bacteria -

denitrifying bacteria -

bacteria of decay -

nitrogen gas -

nitrates in soil -

ammonia in wastes -

protein in organisms -

7. Energy (ATP) Cycle - Trace the flow of energy from the sun through all the organisms of the food web to the environment. Relate this to the phosphate cycle (text p. 539)

8. Consider the food web, energy flow and cycles, and list the three main factors necessary for an ecosystem to be self-sustaining (self sufficient).

9. List some items that man can recycle. List some items that man can reuse.

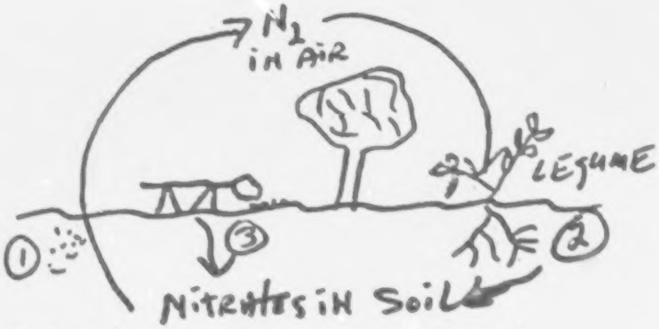
10. What are the problems involved in recycling solid wastes? (Think in terms of cost and energy)

ECOLOGY QUIZ: CYCLES
FORM D

NAME ______________________________

1 - 3 Which type bacteria is represented by each number in the diagram below?

A) nitrifying bacteria
B) purple sulfur bacteria
C) nitrogen - fixing bacteria
D) denitrifying bacteria



_____ 1.

_____ 2.

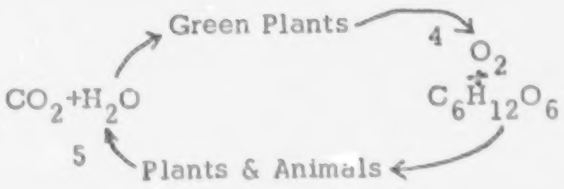
_____ 3.

4 - 5 Refer to the cycle diagramed below and identify the processes represented.

A) photosynthesis
B) nitrogen - fixation
C) aerobic respiration
D) anaerobic respiration

_____ 4.

_____5.



_____ 6. Which of the following is not part of a normal water cycle?

A) precipitation
B) fall-out
C) transpiration
D) evaporation

_____ 7. Compare with the carbon dioxide concentration in a lake during daylight hours, the concentration during the night is usually

A) lower, because at night fish exhale less carbon dioxide
B) lower, because at night the water is warmer than the surrounding air
C) higher, because at night the plants in the lake do not use carbon dioxide
D) higher, because at night fish are more active

_____ 8. In a food chain, light energy is converted to chemical bond energy by

A) producers
B) decomposers
C) second-order consumers
D) first-order consumers

_____ 9. The more complex plants generally absorb nitrogen from the soil in the form of

A) free nitrogen
B) nitrates
C) proteins
D) amino acids

_____ 10. Which process is represented below?

$C_6H_{12}O_6 + O_2 \qquad CO_2 + H_2O + ATP$

A) aerobic respiration
B) anaerobic respiration
C) photolysis
D) carbon-fixation

BIOLOGY WORKSHEET #7
BIOMES

NAME ______________________________

Before answering these questions, read in your text pp. 547 - 51, and look at the pictures in Molecules to Man pp. 722 - 3

1. Define biome -

2. What factors in addition to altitude and latitude determine the index vegetation in each biome.

3. List the biomes in order of increasing temperature.

4. Match the dominant plant with the biome.

PLANT	BIOME
___ coniferous trees	A. tiaga
___ herbs & grasses	B. deciduous forest
___ broad leaf trees	C. grasslands
___ lichen & mosses	D. desert
___ lush leafy plants	E. tundra
___ cactus	F. rain forest

5. Match the biome with a description of its climate.

CLIMATE	BIOME
___ Precipitation usually frozen, ground rarely thaws, little sunlight.	A. Taiga B. temperate deciduous forest
___ Over 80" of rain annually, temperature never drops below freezing, much sunlight except during monsoon season.	C. grasslands D. tundra E. desert
___ Annual precipitation between 30-40", 4 distinct seasons, freeze thaw line crossed frequently during winter.	F. tropical rain forest
___ Less than 10" of rain annually.	

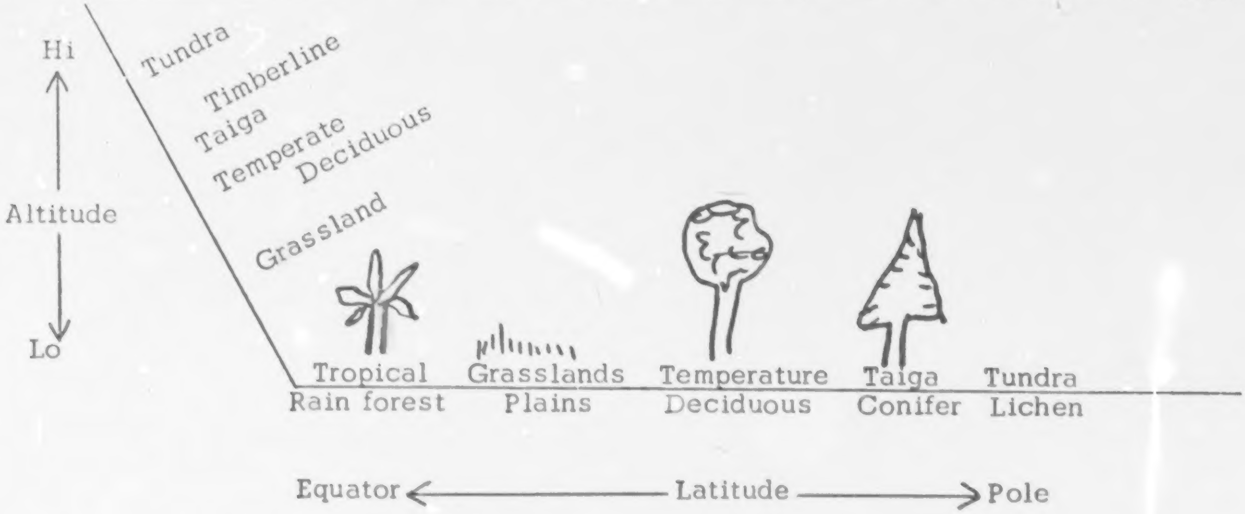
6. In which biome do we live? What is the climax vegetation?

7. Choose any biome except temperature deciduous forest and describe its A) climate, B) vegetation, C) wild life, D) landscape

BIOLOGY WORKSHEET #7
Page 3

Biomes - distinct geographical area

(A) Land - Terrestrial - named by climax vegetation (which determines animal types)


Hi
Altitude
Lo
Tundra
Timberline
Taiga
Temperate
Deciduous
Grassland
Tropical
Rain forest
Grasslands
Plains
Temperature
Deciduous
Taiga
Conifer
Tundra
Lichen
Equator
Latitude
Pole

(B) Aquatic - Freshwater

(C) Marine - Saltwater

70% earth's surface, plant distribution not control habitats but O_2, CO_2, temperature and minerals (salt concentration), least temperature variation greatest amount food production = costal waters

BIOLOGY QUIZ: BIOMES
FORM Q

NAME ____________________

____1. Which is the proper sequence of altitudinal life zones from sea level to mountain tops?

a) tundra, taiga, temperate deciduous forest, tropical rain forest
b) taiga, temperature deciduous forest, tundra, tropical rain forest
c) temperature deciduous forest, tundra, taiga, tropical rain forest
d) tropical rain forest, temperate deciduous forest, taiga, tundra

____2. The greatest amount of food production in the world occurs in which biome?

a) tundra
b) tropical rain forest
c) ocean
d) grassland

____3. One would expect a climax community to show

a) considerable change regardless of climate
b) rapid changes in short periods of time
c) no change unless the environment changes drastically
d) a fluxuating population of animals only

____4. The beech-maple climax forest of northern New York State is part of which world biome?

a) tundra
b) taiga
c) coniferous forest
d) deciduous forest

____5. A biome in which animals greatly outnumber plants would most likely be found in

a) the deep ocean basins
b) an open grassland
c) a tropical rain forest
d) any New York State marsh

6 - 9 MATCHING

Description

____6. This area receives little solar energy at any time. It has a short growing season, its precipitation is low and occurs largely in the form of snow. Its soil is frozen most of the year.

____7. Trees in this area have broad leaves that are shed in the fall. The weather is variable with snow seldom lasting all winter.

____8. This area has great coniferous forests extending in the broad zone across Eurasis and North America. It has a multitude of lakes & ponds.

____9. Over eighty inches of rainfall per year in this area are evenly distributed so that there is no well defined dry season.

Biome

A) temperate deciduous forest
B) grassland
C) tundra
D) tropical forest
E) taiga

_____10. Which is **NOT** essential in a self-sustaining ecosystem?

a) equal numbers of plants and animals
b) a living system capable of incorporating energy into organic compounds
c) a constant energy source
d) a cycling of carbon between organisms and their environment

BIOLOGY
FILMSTRIP WORKSHEET #8

NAME ______________________________

Environmental Pollution (Wards 70W3800)
#1 Nature of the Crisis

1. Define environmental pollution.

2. List four examples of natural pollution.

3. List four examples of man generated pollution.

4. State four ways pollution is harmful to man.

5. In what way does pollution create a negative visual impact?

6. How do insecticides harm birds?

7. How are fish affected by sediment in a stream?

8. How does an algae bloom affect other aquatic organisms?

9. How does air pollution affect land vegetation?

10. What type industry causes thermal pollution?

11. How can the nitrogen cycle be upset by pollution?

12. Why is there so much more pollution now than 100 years ago?

13. List four waste disposal methods that are needed.

BIOLOGY WORKSHEET #9 NAME ______________________

THERMAL EFFECTS ON AN AQUATIC ECOSYSTEM

All forms of life (esp. heterotrophs) are dependent upon oxygen for their existance. Oxygen makes up water which is the most common molecule in living organisms (70-95%). Free oxygen is also required by all animals and most protists in the cellular oxidation of glucose. It is this process through which these organisms obtain energy (ATP).

Land animals obtain free oxygen from the air (atmosphere) around them. Aquatic animals (except mammals) depend on oxygen that is dissolved in the water of their environment.

A number of factors can effect the amount of oxygen dissolved in water (DO). Heat is a factor which directly effects the DO of an aquatic ecosystem.

Using the Hach method of determination of DO calculate the DO of various water samples of different temperatures. Record your observation on a data chart. Graph you results.

1. Explain the relationship between water temperature and DO.

2. How could water which is heated above its normal temperature effect the ecosystem.

3. Nuclear Power Plants (as Nine-Mile Point at Oswego), and other industries (ex. Solvay Process) discharge heated water into aquatic ecosystem, because they use water to cool some process. Explain using DO content, algae growth, etc. how thermal pollution effect an aquatic ecosystem.

4. An increase in algae can be caused by fertilizers from agricultural run off (phosphates, nitrates) as well as temperature increases. This growth forms a "blockage layer" preventing light penetration. How will this affect the DO?

DATA CHART

Temperature vs. Dissolved Oxygen

Your group's individual data:

TEMPERATURE	(DO)

Combined Class Data:

TEMPERATURE	(DO)

BIOLOGY
SURPRISE QUIZ

NAME ______________________________

1. Using the following data, construct, label, etc. a graph representing the data:

Temperature (C^{o})	DO (ppm)
1	81
3	67
3	77
8	66
10	54
15	50
15	48
16	51
19	42
20	42
25	37
25	30
30	22
30	12
38	15
39	11
40	8
40	9
41	7
45	8
50	1
50	5

2. Does this graph show a positive or negative correlation?

3. How does how water effect an aquatic ecosystem?

4. Describe the difference between a population and ecosystem, give examples of each.

5. List four limiting factors on a population:

MATERIALS FOR THERMAL EFFECTS LAB #9

2 D.O. Bottles (for each group of 5)

Hach D.O. test kits or contents

5 thermometers

hot plate

ice cubes & styrofoam container

5 - 1000 wl beakers

pond water - (1) some to be boiled, (2) some heated slightly warmer than room temperature, (3) some chilled overnight in refrigerator with ice added, (4) some slightly colder than room temperature, (5) some at room temperature. One gallon of each should be enough for one class.

graph paper

Teacher & Student References - Books

* most functional

1. Andrews, (Ed.). Environmental Pollution. Prentice-Hall, N.J., 1972.
2. Andrews, (Ed.). Freshwater Ecology. Prentice - Hall, N.J., 1972.
3. *BSCS. Biological Science: An Inquiry Into Life (yellow). Harcourt, Brace & World, N.Y., 1968.
4. *BSCS. Biological Science: Molecules to Man (blue). Houghton - Mifflin, N.Y., 1968.
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7. BSCS. Student Lab Guide (to yellow version) 2nd ed. Harcourt, Brace & World N.Y., 1968.
8. Comstock, A. A Handbook of Nature Study. Cornell University Press, Ithaca, N.Y., 1939.
9. Ehrlich, P. The Population Bomb. Ballantine Books. 1968 (301.35).
10. Knight, C., The Basic Concepts of Ecology. MacMillan, N.Y., 1965.
11. Kormandy, E. Concepts of Ecology. Prentice - Hall, N.J., 1969 (574.5).
12. *Kraus, D. Concepts in Modern Biology (Concepts). Cambridge, N.Y., 1969.
13. Leopold, A. A Sand County Almanac. Oxfore University Press, N.Y., 1949.
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17. Stock & Bancheri Investigations In Modern Biology. Cambridge, N.Y., 1969.
18. **Weinberg, S. Biology, An Inquiry Into the Nature of Life. (Text) Allyn & Bacon, Boston. 1971.
19. Weinberg, S. Biology Lab Mannual. Allyn & Bacon, Boston, 1971.

References: Films

From: Mrs. Stella Kroft
Film Librarian
State College of Forestry & Environmental Studies
Syracuse, New York

These films are all free and in color.

Multiply and Subdue the Earth - 67 min.

Population Ecology - 21 min.

Pollution is a Matter of Choice - 52 min.

Strange Partners - 12 min.

Temperate Deciduous Forest - 16 min.

Tropical Rain Forest - 17 min.

What is Ecology? - 11 min.

Woodduck's World- 30 min.

From: Syracuse University Film Library , Syracuse, New York

Care Community - 13 min. - $5.00

Community - 11 min. - $4.25

Desert - 21 min. - $6.75

High Arctic Biome - 22 min. - $6.75

Plant & Animal Communities: Interrelationships - 14 min. - $8.00

Plant & Animal Communities:- Ecological Succession - 14 min. - $7.00

Succession: From Sand Dune to Forest - 11 min. - $6.00

IDENTIFICATION KEYS IN ES-M LIBRARY

580, Jaques, Plant Families: How to Know Them

580, Mathews, The Book of Wildflowers for Young People

582, Collingwood & Brush, Knowing Your Trees

582, Apqar, Trees of the Northern U.S.

582, Dana, How to Know the Wildflowers

582, Emerson, Our Trees and How to Know Them

582, Grimm, Familiar Trees of America

582, Keeler, Our Native Trees

582, Lemmon & Johnson, Wildflowers of North American

582, Mathews, Fieldbook of American Trees & Shrubs

582, Mathews, Fieldbook of American Wildflowers

582, Peattie, A Natural History of Trees

582, Platt, American Trees

582, Rogers, First Book of Tree Identification

582, Wherry, Wildflower Guide (N.E. USA)

582, Zimm & Martin, Flowers

582, Zimm & Martin, Trees

582.13, Cuthbert, How to Know the Fall Flowers

582.13, Cuthbert, How to Know Spring Flowers

582.13, Carey, Wildflowers at a Glance

584 Pohl, How to Know the Grasses

586, Sterling, The Story of Mosses, Ferns, & Mushrooms

587, Cobb, Field Guide to the Ferns

587.3, Durand, Fieldbook of Common Ferns

588, Conrad, How to Know the Mosses & Liverworts

589.3, Prescott, How to Know the Freshwater Algae

591.92, Morgan, Fieldbook of Ponds & Streams

592, Jahn, How to Know the Protozon

595, Comstock, The Spider Book

595, Kaston, How to Know the Spiders

595.7, Jaques, How to Know the Beetles

595.7, Jaques, How to Know the Insects

595.7, Lutz, Fieldbook of Insects

595.7, Zimm & Michell, Butterflies & Moths

595.7, Swain, The Insect Guide

595.7, Zim & Cottam, Insects

597, LaMonte, North American Game Fishes

597, Zim & Shoemaker, Fishes

598, Peterson, A Field Guide to the Birds

598, Zim & Gabrielson, Birds

598.1 Ditmars, Reptiles of North America

598.2, Jaques, How to Know Land Birds

599, Zim & Hoffmeister, Mammals

EAST SYRACUSE-MINOA SCHOOLS

Environmental Education Materials

High School Package

Environmental Physics

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by East Syracuse-Minoa Central Schools
407 Fremont Road
East Syracuse, N.Y. 13057
Dr. Fritz Hess, Superintendent

INTRODUCTION

Rarely will a master teacher take a curriculum from another teacher and follow it exactly. That is not the purpose here. But it is felt that the many facts and suggestions contained within will be a valuable aid to any course in environmental science.

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The major topics are:

1. Noise
2. Air Pollution
3. The Automobile
4. The Bicycle
5. Aircraft
6. Solid Waste
7. Water
8. Electric Power

I made every effort to sound as if I was speaking to the student through the teacher, who would, of course, interject his own reasoning, questions and personality.

Occasionally you will find a suggested student project. These research project suggestions are based on topics which I feel can become an integral part of the course, if the students do a good job. The teacher can measure his own success in terms of the success of his students' projects, of which there should be many.

I also suggest as many ecologically oriented films as possible. If the students actually enjoy the course, so much the better.

NOISE POLLUTION

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Noise

I. Introduction	I. 1. A pressure wave. 2. Unwanted sound. 3. Transferred through air - called a form of air pollution 4. Can destroy hearing. 5. Can be used for killing. 6. Creates loss of sleep. 7. Irritation
II. When you stop sound, there are no residuals.	
III. Sources A. Transportation 1. aircraft 2. automobiles	III. Sources A. Transportation 1. including sonic booms 2.a. noise of tires at high velocity. b. engine noise increases with speed.
B. Occupations 1. Industrial revolution brought noise. 2. Automatic riveters, air hammers.	B. Occupations 1.a. making of iron b. Have you ever visited an iron forgery? (Question) 2.a. Operators usually lose hearing while still young men. b. Some industries have maximum time limits to be on machines.
C. Communities 1. Increase as society becomes more affluent.	C. Communities 1. Washing machines, dishwashers, can openers, air conditioners, lawnmowers, snowmobiles, motorcycles.
IV. How We Hear A. Parts of ear 1. Ossicles 2. Acoustical control muscles	IV. The ear interprets pressure waves as sound. A. 1. Ossicles - 3 small bones in ear; shaped as a lever to multiply the pressure. 2. Acoustical Control Muscles (two) a. When noise is too high, these muscles cut down on motion of ossicles to prevent too much energy from damaging ear hair cells (nerve cells - called cocklia). b. Question: Have you ever heard sounds loud enough to cause pain? What were they?

V. Some Reactions to Noise	V. A. Noise can act on hypothalamus section of brain to increase the flow of adrenalin. Constant drain on adrenal gland is bad. B. Constrict blood vessles. Raise blood pressure. C. You can become conditioned so you react sooner (jump) when certain noises are heard. Heart attack. Tranquilizers are sometimes prescribed.
VI. Control A. At the source B. Sound proof the listener.	VI. Society is more interested in spending for cures than for prevention.
VII. The Sound Pressure Wave	VII.
A. Compressions and rarefactions.	A. High and low pressure parts of sound wave.
B. Frequency (pitch)	B. The number of times the high-low cycle is repeated each second determines the pitch. Demonstrate using vibrating meterstick held to table edge.
C. The Frequency Range 1. Infrasonic Range	C. The Frequency range of sound. 1. Below 20 cycles per second (20 hertz). Can't be detected by human ear. a. Used to crumble earth in mining operations. b. Can kill.
2. The Audable Range	2. 20 - 20,00 cps a. Speech mainly 200 - 3500 cps b. As you grow older, you lose the top octave (1/2 or 10,000 - 20,000 cps) or more. (Can't hear very high frequencies). c. High pitch noise is more disturbing than low pitch. d. High pitch becomes more disturbing as you grow older even though you hear it less.
3. Ultrasonic	3. Above 20,000 cps. Can't be detected by the human ear. a. Dog whistle b. Ultrasonic cleaning. In jewelry stores. c. Kills bacteria - sterilize.
4. You can often feel sounds you can't hear.	

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VIII. The Inverse Square Law	VIII. The Inverse Square Law
A. Sound Power, P.	A. The rate at which sound energy goes by.
B. $P \; d \; \frac{1}{r^2}$	B. The sound power varies inversely with the square of the distance (r) that the listener is from the source of the sound.
C. Example	C. Example: a. While listening to your stereo (or quadraphonic) recorder, a sound reaches your ears. If you then move 5 times farther away from the loudspeakers, what power will reach your ears? $P \propto \frac{1}{r^2} = \frac{1}{(5)^2} = \frac{1}{25}$ of the origional power. $\frac{1}{25} \cdot 50 \times 10^{-6}\,wt = 2 \times 10^{-6}\,wt$ b. At this time your amplifier is using 10 WATTS of electric power. To make it sound exactly as loud in your new location as it did when you were closer to the loudspeakers, you have the volume turned up. When you succeed, what power will the instrument be using? 25 X 10 WATTS = 250 WATTS What effect do you think this will have on someone who remains at your old location, closer to the speakers?
D. Pressure waves created by powerful amplifiers can and do cause damage.	D. 1. Rock groups, electric guitars, music lovers' Hi-Fi's 2. Damage hearing, crack wall plaster, etc. 3. Irritation to neighbors -- neighbors feel less private.
IX. Another reason for excessively amplifying sound.	IX. Our ears are not sensitive to very high and very low frequency (pitch) sounds so to hear them better, most amplifiers have special curcuits (usually called loudness contours) to highly boost the power at these frequencies. To your own ear they sound normal but the pressures exerted against the walls of the room may be tremendous.

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Project: Play a record containing many bass notes (low pitch sounds) through a good amplifier.

1. Hold a lighted candle in front of the loudspeaker to notice the pressure waves.
2. Go outside of the house and close the door. Notice how the bass notes penetrate the walls. Why?

X. How our ears interpret Loudness. Our ears hear in a logarithmic way.

X. To make a sound seem twice as loud, you need to increase the sound power 10X [not just 2X]. To make it 4X louder, increase power by 100X, etc.

If you are able to turn up the volume of a powerful amplifier until your ears tell you it is 8X as loud, you have turned loose 1000X the power to penetrate the neighborhood.

XI. How much sound power do wo need to hear a noise?

XI. The threshold of hearing

A. Most people can detect sound if the power reaching their ear equals only 10^{-16} watts. This weakest sound level people can hear is called the threshold of hearing.

B. The air atoms collide with our ear drums with nearly 10^{-15} watts. If our ears were more sensitive, we could hear the air atoms vibrating.

C. Normal converstion has about 1,000,000 the power as the threshold of hearing.

D. The threshold of pain is about 1,000,000 the sound power of normal conversation. This amount of sound is very excessive. It hurts!

XII. How Loudness is measured.

decibels (db) = $10 \log \frac{I}{I_0}$.

XII. The unit of sound loudness is called the decibel.

A. This scale is a logarithmic scale and is based on the way the human ear hears loudness.

B. All sound powers are compaired to a set standard, the threshold of hearing, $I_0 = 10^{-16} \frac{\text{WATTS}}{\text{cm}^2}$.

(note: The ear opening is about 1 cm^2 in area.)

C. Here are examples of the difference between two sounds of different loudness.

1 db difference - smallest change perceptible.
3 db difference - moderately noticeable, means one sound has twice the power of the other.

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10 db difference - One sound seems twice as loud as the other but actually has 10X the power. (Remember: this is a log scale to the base 10).

60 db difference - One sound has 1,000,000 times the power of the other.

D. Here are some common sounds placed on the decibel scale:

Sound Quality	Decibels	Sound Source
Threshold of hearing	0 db	Sound proof room
Very faint	10 db	Whisper Rustle of leaves
Faint	20 db	Quiet Conversation Average auditorium Private office Quiet home
Moderate	40 db	Quiet radio Ordinary conversation Average office Noisy home
Loud	60 db 70 db	Average factory Normal radio Average traffic Noisy office
Very Loud	80 db 90 db	Police whistle Pneumatic drill Screaming child Noisy factory Loud street noises Pushing power lawnmower Wood saw, punch press

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Sound Quality	Decibels	Sound Source
	100 db	Subway and elevated train Thunder
Deafening	110 db	Nearby riveter, drop hammer Boiler factory Propeller aircraft 4 piece rock band
Threshold of Pain	120 db	Turbojet: 7,000 16 Thrust Rocket engine

XIII. Sound reduces business efficiency.

XIII. Tests have shown increases in both O_2 consumption of workers and the time to complete a task as the sound level goes up.

A. Sound especially annoying when it is unexpected or judged to be unnecessary.
B. Reverberation
C. High pitched sounds judged more annoying than low pitched sounds -- even at low loudness level.

XIV. White noise.

XIV. Certain noises (i.e. background static on radio or TV set not tuned to a station.), called white noise, are so detrimental to thinking and concentration that dentists use them on patients instead of anesthesia. (Through earphones on patients ears.)

Projects:

1. Research - What is white noise (sometimes called pink noise) and what are its uses.
2. Devise some sort of exam to administer to the class both with and without white noise (you can use radio static). Can you come to any conclusions?

XV. Sonic Booms

A. The speed of sound.

XV. Sonic Booms

A. At room temperature, the velocity of sound is approximately:

$$\left.\begin{array}{r}1100 \text{ ft/sec}\\ 330 \text{ meters/sec}\\ 770 \text{ miles/hr}\end{array}\right\} \text{MACH 1}$$

The velocity of sound is slower at colder temperatures such as higher in the atmosphere.

XV. Sonic Booms

B. What happens when an aircraft flies faster than the sound waves it creates?

XV.

B. Sound spreads out uniformly in all directions from a stationary source.
1. If the source (the aircraft) is moving, the sound pressure waves cannot pull away from the forward part of the source at as great a rate.
2. When the source velocity equals the speed of sound (i.e. and aircraft flying at MACH1), the sound waves can't move out ahead of the source at all and tend to build up in pressure and energy on the forward face.
3. The sound pressure waves build up on the wings and nose section surfaces of an aircraft and leak off the sides and head toward the ground as a concentrated cone of very high pressure (loud sound.)
4. If this pressure wave passes over your location, you feel a quick, sharp push. The frequency is so low and it happens so fast as to rarely be audible. If you're inside of a building, you hear the building shake, as if someone dropped something very heavy on the rood.
5. There are usually two "booms" in quick succession, one from pressure waves on wings of aircraft and one from the tail section surface.

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C. Sonic booms can really cause damage on the ground.

C. Damage
1. The airforce denied this for years, but every science students knows what air pressure can do.
2. Broken windows
3. Cracked plaster
4. Have set off burgular alarms
5. Rockslides and avalanches.
6. The sudden feeling of the pressure burst when you're outdoors where you probably won't hear any sound. Feels "like your heart skipped a beat."

D. Means for control.
1. Laws.
2. The elevation of the craft.
3. What is the "Sound Barrier"?

D. Means for control.
1. Prevent aircraft from flying below certain altitudes or from exceeding the speed of sound.
2. The farther the pressure wave must travel before it reaches your ears, the weaker it will be when it arrives.
3. Once the speed of sound is reached, going faster doesn't produce any increase or decrease in sonic boom effect. The term "Breaking

	through the Sound Barrier" is meaningless as there is not actual barrier to go through.
4. Streamline the plane	4. a. Blunt surfaces build up stronger pressure waves. Sharp, slanted surfaces let the waves leak off before they grow too strong. b. Streamlining the craft also allows it to go faster, less air resistance. The increase in velocity will not increase the strength of the sonic boom. c. The higher velocity will allow the plane to fly higher (farther from the ground.) d. Increase stability of craft. Vibrations make noise which adds to the sonic boom pressure wave.
5. Sound Proof Buildings	5. Expensive and impractical. Yet sound proofing of a building also insulates for heat and cold at the same time (a bonus).

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AIR POLLUTION

AIR POLLUTION

I. This chapter mainly serves as background study to prepare for future chapters and should not be considered a complete study of air pollution.	
II. The Cost of Air Pollution A. Money	II. How we pay. A. Money - about $12 billion in U.S.A. alone. Europe is as bad. 1. crop failure 2. laundry 3. airlines can't fly somedays 4. SO_2 eats automobile tires 5. clothes wear out sooner 6. clean house more often.
B. Health	B. Health 1. Sickness: Between 1955 and 1965 there has been a 300% increase in resperatory disease of children in New Jersey. 2. 1963 Thanksgiving Day - 400 people died in New York City (air inversion). 3. 1962 December and January - London - 3 - 4,000 died.
III. The ecologic balance depends on Oxygen and CO_2 in air.	III. Only 21% of the air is O_2 (animals) Only .03% of the air is CO_2 (plants)
IV. How much air do we need?	IV. Each person A. 20,000 inhalations per day B. 8 liters/min C. 11,500 liters/day

V. Pollutants

V. What pollutes the air.

- A. The burning of organic fuels
    - 1. Hydrocarbons
    - 2. Carbon monoxide
    - 3. Oxides of sulphur
    - 4. Oxides of nitrogen
- B. Particles - Smoke particles such as unburned carbon (soot).
- C. Particle sizes
    - 1. >10 microus ($1\mu = 10^{-6}$ meter)
        - a. Settles out of air rapidly
        - b. >40 microus ejected by nose, no problem
        - c. A 20μ particle settles out at 3600 cm/hr in still air. It would fall from a 250 foot smoke stack to ground in 2.1 hrs. This is not a worry.
        - d. A $.3\mu$ particle settles out at 2 cm/hr. It would fall from a 250 ft stack to the ground in 2500 hrs. It would be in the air for months. This is a worry.
    - 2. $1 - 10\mu$ most common in cities.
    - 3. $.1 - 1\mu$ most common outside of city.
- D. The smaller the particle, the worse it pollutes the air.
    - 1. Tobacco smoke is the smallest.
    - 2. Rain has little affect on particles $< 2\mu$.
    - 3. Asbestos particles are very small.

Student research project: How much of a hazzard are automobile break linings to air pollution?

- 4. The breaking up of large particles into smaller ones by grinding, spraying, road dust.
- 5. 150 grams/m^3 of particles in the air will reduce visability from 20 miles to only 5 miles.

VI. The Automobile, our worst offender.

VI. The Automobile - Produces 60% of air pollution.

- A. 2 1/2 lb CO (poisonous) for each 20 miles traveled by each car. This would occupy 35 ft^3.
- B. 85% of CO generated in U.S.A. comes from auto exhaust.
    - 1. U.S. air is 1: 10^7 parts CO (Carbon monoxide)
    - 2. 1: 10^4 parts CO is dangerous and greater amounts will kill or destroy the brain.

3. N.Y.C. traffic often exceeds this.
   a. In N.Y.C. 2,500,000 cars drive into the city each day. (In N.Y.C. 60,000 cars are abandoned on the streets each year = no. of autos in the entire city of Moscow, U.S.S.R.)
   b. San Palo, Brazil also has 2.5 X 10^6 cars.
   c. In Japan, traffic police wear breathing masks. Have oxygen tanks nearby.
4. The cigarette also produces CO. 1700 p.p.m. from one cigarette.

VII. Incomplete combustion mainly responsible.

VII. Project: Hold a clean test tube over flames from
1. candle.
2. Match
3. poorly adjusted bunsen burner
4. carefully adjusted bunsen burner.

Observe the soot produces. This is unburned carbon. The main reason for the unburned carbon is not enough O_2 present.

VIII. Other chemicals in the air.

VIII. SO_2 from auto exhaust
A. SO_2 combines with O_2 and water vapor in the air to make sulphuric acid.

$$SO_2 + O_2 \qquad SO_2 + H_2O \qquad H_2SO_4$$

B. In Venice, rain water erodes the marble statues. Why?
Student Project: Test rain water with litmus paper for acidity. Test while rain is falling and at various locations.

C. Not all SO_2 is from auto exhaust

1. Niagara Mohawk changes power transformers every 10 - 15 years.
2. But in Solvay they often have to change them every 2 years.

IX. Volcanos

IX. Volcanos produce 1/3 of the H_2S in the air; man 2/3. But we can do something about our 2/3.

X. Pesticides

X. DDT has a half life of 15 years.

Objective: To determine the amount of dustfall in a specific location.

Time interval: Begin experiment either November 4 or November 11.
30 days

Technizues: Three wide-mouth, gallon glass jars should be cleaned and rinsed with distilled water. Put one quart of distilled water into each jar. Label each jar at the water level with transparent waterproof tape. Place jars outdoors, five feet off the ground. Keep the water at its initial level. Add distilled water if necessary.

Soak three wooden sticks in distilled water for three days to remove soluble materials. Add a stick to each jar to prevent cracking.

DUST IN THE ATMOSPHERE

Part II After 30 days.

1. Bring the sample into the laboratory and evaporate most of the water from the jar using a hot plate or water bath. Place an asbestos pad on hot plate to protect jar from breakage.

2. Carefully wash down sides and bottom of jar with small amount of distilled water from wash bottle, scrubbing all surfaces of inside of jar with stirring rod.

3. Transfer the total sample, a little at a time, to a weighed evaporating dish and evaporate all the water either on a hot plate or water bath. Avoid overheating.

4. When dry, cool the dish and contents and weigh to the nearest centigram or milligram. Subtract the weight of dish from the combined weight of dish and contents to obtain the net weight of dustfall.

5. Average the results of the three bottles.

- -

Calculations

1. Measure the inside diameter of the mouth of each jar in centimeters.

2. Calculate the area of the open mouth of each jar.

3. Determine the dustfall in $mg/cm^2/30$ days.

4. To convert $mg/cm^2/30$ days to tons/square mile/30 days, multiply by 28.6 tons/square mile.

- -

An alternative method for evaporating the final portion of sample is to transfer it to a volumetric flask, invert the flask over the evaporating dish to form a chicken feeder evaporator, and then evaporate the sample to dryness at about 100° C.

- -

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Particles that are in the air vary greatly in size. The table indicates the size ranges of some typical particles found in the air.

TYPE OF PARTICLE	DIAMETER IN MICRONS
Raindrops	500-5000
Sand	200-2000
Pollen Grains	20-60
Pulverized Coal	10-400
Cement Dust	10-150
Plant Spores	10-30
Ash from coal-fired furnace	3-80
Natural Fog	1-40
Silca Dust from Mines	0.5-10
Chemical Fumes	0.5-10
Carbon Smoke	0.1-1
Tobacco Smoke	0.01-0.25

Free: Air Pollution 16 mm Movies. Order from:

National Medical Audiovisual Center
Station K
Atlanta, Georgia 30324

M-1739/16	Don't Leave It All To The Experts	16 min.
M-1707	Beware The Wind	22
M-1774	The Run Around	11
M-1712	On A Clear Day You Can Almost See Terminal Tower	22
M-1418	The Poisoned Air	50
M-1419	Air of Disaster	50
M-1430	With Each Breath	30
MIS-984	Ill Winds On A Sunny Day	28
M-1420	This Business of Air	30
M-1431	It's The Only Air We've Got	25
M-1530	A Matter of Attitudes	30
M-1540	Air Pollution: Take A Deep Deadly Breath	54
M-1600	A Day At The Dump	15
M-1624	Air Pollution in New York-New Jersey Area	15

Filmstrips

Beware of Ill Winds	1745X
Air Pollution & You	1528X

All of these visual aids are in color.

THE AUTOMOBILE

THE AUTOMOBILE

I. Our major source of air pollution.

I. Why? Because we have so many
   A. All of the cars in the U.S. would not fit on the roads and highways at the same time.
   B. Air pollution was a serious (smog) problem as early as 1949 in Los Angeles.
   C. Air inversions
      1. Cities in low valleys
      2. Air near ground is trapped by heavy air layer above.
      3. Air stagnates. Especially as more and more pollutants are poured into it.
   D. Auto pollution is mainly an urban problem
      1. More traffic into cities and out.
      2. Tall buildings trap air - less air circulation.
      3. 60 - 85% of air pollution is in cities.
      4. Urban lung cancer rate is proportional to the size of the city.
      5. Should autos be banned from cities except for buses and taxis?
      6. 14,000 tons of pollutants added to Los Angeles air each day. 87.4% is due to auto (year 1967).
      7. In 1967, Syracuse ranked 49th in air pollution.

II. How many cars are there in the U.S.A.?

II. Here is a chart showing how the automobile crept into our lives:

year	cars	population	average cost
1900	8,000	76,000,000	$1,250
1910	458,400	92,000,000	1,200
1920	8,131,500	106,970,000	950
1930	23,000,000	123,000,000	590
1940	27,500,000	132,000,000	650
1950	40,400,000	152,000,000	1,270
1960	61,700,000	180,700,000	1,900
1970	105,000,000	205,000,000	2,275

Sooner or later they all end up in the scrap heap.

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III. Leaded gasolene	III. Lead was first added to commercial gasolene in 1923 to prevent pre-ignition.
A. Pre-ignition	A. As gasolene is compressed in the cylinders of the engine by the piston, the high pressure may cause the gas to ignite before the spark plug has the chance to fire. The push will occur at the wrong time causing loss of engine efficiency and even damage. Leaded gas can withstand the higher pressures without pre-ignition. (Knocking).
B. Lead is a good engine lubricant.	B. Lead is a very soft metal.
C. But lead is poisonous.	C. Lead concentrations of .8 p.p.m. can cause illness. Many cities experience 3 times this much, often. 1. Lead represents only .35% of auto exhaust. 2. But it is very poisonous. 3. And there are many cars.
D. The PCV valve	D. This little devise was designed to take unburned vapors from the crank case and send them back to the engine to be reburned. 1. Lead clogs the PCV valve. 2. Lead will clog nearly any anti-pollution filter. 3. Before automobiles can be prevented from polluting air by means of installing engine filters, the cars will have to stop burning leaded gas.
IV. Low lead and no lead gas.	IV. Its here. A. So far only 3% of the consummers have switched to low lead gas. B. What about pre-ignition? 1. New cars are designed with a lower compression ratio. 2. Other additives have substituted for the lead. 3. Octane a. The higher the compression ratio of the engine, the more octane needed. Octane is the anti-knock measurement of a fuels performance as compared to an agreed upon industry standard of iso-octane and heptance. b. Lead raises octane c. The additives in low lead gasoline used to raise octane in place of the lead are called aeromatics.

	d. Aeromatics pollute too but anit-pollution devices may be able to filter them out without clogging once the lead is gone.
V. How long will it take to de-pollute the automobile?	V. It takes time. A. The average car life is 10 years. B. Any anti-pollution equipment law passed now for all new cars sold would not affect up to half the cars driven for 5 years. C. Older cars can't use low lead gas as safely because of their higher compression ratio. (some can). Hence the lead would clog anti-pollution devices added to older cars. D. Without the lead in gas to lubricate, parts will wear faster. Newer cars have harder, heat-treated valves and valve inserts.
VI. The Catalytic Converter	VI. Can change organic exhaust pollutants into CO_2 and water. A. Not in use yet. B. No lead gas would have to be used to prevent clogging.
VII. Computerized Fuel Injection.	VII. The fuel is precisely metered before it is sent into the engine so there is no waste (incomplete combustion). 1. Electronic control system needed. 2. Increases power and gas efficiency. 3. The partial elimination of weting of intake engine parts by gasoline. Project: What are Barium Fuel Additives and will they really reduce auto air pollution?
VIII. The External Combustion Engine.	VIII. The fuel is burned outside of the engine rather than internally. A. The energy is piped in. B. Usually a form of steam engine. C. Steam under pressure is sent into the engine under careful control. This pushes rotary blades. D. After being used, the steam is returned to external boiler to receive more energy. E. As you can tell, this is not a new idea. F. Very efficient G. But these engines are bulky. H. It takes a long time to initially heat the water into steam to get the car started.

IX. The Internally Combusted Stirling Engine.

IX. Designed by Robert Stirling over 100 years ago.
- A. The burning fuel produces gases which are heated and expand under pressure and push the pistons.
- B. Will run on crude fuels.
  - 1. oil
  - 2. kerosene
  - 3. salid dressing.
- C. Engine runs very hot so parts must be very heat resistant. Not possible 100 years ago but maybe today.
- D. Engine must be well sealed to keep gas from escaping. Hence gases stay out of atmosphere.

X. The Electric Car

X. Batteries are better today than 20 years ago thanks to space research.
- A. Here care some possible specificiations.
  - 1. Tri-polar lead-cobalt batteries
  - 2. D.C. motor capable of speeds from 0 - 7000 rpm.
  - 3. Solid State control unit.
  - 4. Means for recharging quickly.
- B. Batteries alone will weigh about 1 ton.
- C. 20 - 120 horsepower.
- D. No air pollution.
- E. No noise.

Student Projects:
- 1. What is your opinion of the Wankle Engine from an economic and ecological point of view?
- 2. The hydrogen-oxygen fuel cell...could it be designed into an electric car?
- 3. Is the Flywheel Drive Car really a toy?

XI. Increasing fuel burning efficiency.

XI. Unburned fuel is our greatest source of exhause emissions.
- A. Polish out all rough spots from engine parts, especially combustion changer. Fuel will flow smoother.
- B. Decrease temperature of engine (from 180°F) to around 220°F to vaporize more hydrocarbons.
  - 1. Not all engine parts as designed today could withstand such high temperatures.
  - 2. High temperatures cause fuels to percolate (bubble-up) and if this occurs, efficiency goes way down.

	C. Air added to exhaust in the exhaust manifold after each cylinder fires to burn some of the pollutants as they pass out of the exhaust system.
XII. Auto fuel is the second largest use of lead in the U.S.A. (Tetraethyllead).	XII. Low lead gas should increase the life of spark plugs, muffler and tail pipe.
XIII. Your car pollutes the air even when it is parked with the motor turned off.	XIII. The open gas tank. A. All gas tanks are vented to the atmosphere by a gas cap which does not fit to a feal. B. The average gasolene tank loses 28 grams of fuel to the air by means of evaporation. There are 100,000,000 cars in the U.S.A. doing this. C. Why don't they seal off gas tanks with a tighter fitting gas cap?

THE BICYCLE

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THE BICYCLE

I. In the past few years, many millions of Americans have taken to fight air pollution by driving a bicycle instead of a car.	I. Perhaps if a person knows more about cycling, he too will be interested in going the cycle route. A. The purposes of this section are to interest the student in bicycling from an ecological standpoint. B. and from a health point of view and C. to help a student select a bicycle with confidence when he is ready to make his purchase.
II. The bicycle is no longer just a form of amusement for youngster.	II. 8,500,000 bicycles were sold in the U.S.A. in 1971. 3,500,000 of these were sold to people over 21 years. A. Bike riding is healthy exercise for your arm, leg and neck muscles. Godd for breathing too. B. 100's of miles of bicycle trails throughout the U.S.A. 1 The longest is the Wisconsin Bikeway. 332 miles. 2. The Erie Canal bike trail. 3. About 5 miles of trail for cycling through Syracuse parks. C. With proper accessories you can handle a load of groceries and a small child. D. You can really see the sights along the way. E. People respond warmly to a cyclist passing by, but not to a man in an expensive car. F. In heavy city traffic, a bike can usually beat a bus, getting there in less time.
III. The different types of bicycles.	III. Bicycles
A. Highrisers	A. Highrisers or spider bikes are mainly for children. They are not easy to control and a heavy rider would tire quickly. Not recommended for adults.
B. Middleweights	B. This is the traditional American style bike. 1. Heavy, sturdy frame of 50 - 60 lbs. This is a bit heavy, but still considered an all purpose bike. Dependable. 2. Fat, balloon tires. Smooth ride. 3. Coster (foot) brake.

C. Lightweight (2 styles)	C. Lightweights. 1. The English style. Most popular. a. about 45 lbs. b. 3 gear speeds c. hand brakes d. average price $35 - $70. 2. Lightweight multi-speed racer. a. 5, 10, or 15 gear speed models available. b. Handlebars curved down c. Some very light, as low as 22 lbs yet full size bicycle. d. Price around $100., but as high as $300. e. The de Raileur gear system requires delicate adjustment and frequent maintenance, but worth it if you can afford it. f. Like a fine sports car.
D. Folding bikes to take with you.	
E. Tandem	E. For two people 1. Expensive 2. Difficult to maneuver in traffic. 3. The stronger rider usually ends up doing most of the work.
IV. Gear Ratios	IV. Be sure the bicycle is designed for the type of riding that you intend to do. It is easier to make a wise choice if you know the purpose of the gear ratio measurement. A gear is a machine.
A. A bicycle is a machine.	A. A machine is a devise used for making work easier to do. It cannot, however, multiply the work (for to do so would violate the basic law of conservation of energy.) Work output = Work input minus work lost to friction.
B. Work, W = FS	B. Work = (Force exerted) X (distance force acts)
C. Mechanical Advantage	C. A machine can multiply force, but only at the expense of losing distance. Example 1: Case 1: Work to lift 300 lbs 2 ft = (300lbs)(2ft) = 600ft-lb. Case 2: Work to lift 30 lbs 20 ft = (30lbs) (20ft) = 600ft-lb. Both Case 1 and Case 2 require the same work, but which one are you physically able to do?

Example 2:

A pulley system is used to life 500 lb. When you pull down on the input rope a distance of 20ft, the weight at the output rope is raised only one foot.

You are cheated on distance by a ratio of 20:1!

Who would want to use such a pulley??

This number 20 is called the Mechanical Advantage.

MA = the number of times your input forces is multiplied. As you lose on distance, you gain on force.

What must your input force have been to allow you to lift the 500lb?

$$(F_{input})(20) = 500\text{lb} \qquad F = 25\text{lb}$$

Only 25lb required to lift 500lb. If you measure the work input and the work output, neglecting losses dure to friction, which work would you expect to be greater? (They are the same).

D. How will the gear ratio give you the mechanical advantage?

D. In a simple gear system, the mechanical advantage equals.

$$\frac{\text{number of gear teeth of 2nd wheel}}{\text{number of gear teeth of 1st wheel}} = \text{MA}$$

Example 1: The first gear on a small bicycle (the one at the pedals) has 45 teeth and the second gear (at the rear wheel) has 15 teeth. What is the mechanical advantage?

$$\frac{\#2}{\#1} = \frac{15}{45} = \frac{1}{3} = \text{MA}$$

But what does this mean?

For whatever force we put in with our feet on the pedals, we get out only 1/3 as much at the rear wheel. We lose on force at a ratio of 1:3, we gain on speed by a ratio of 3:1. This explains why it is difficult to pedal up a hill. But we get there faster (if we don't give up.)

Example 2:

A red bicycle has a gear ratio of 33:1

A blue bicycle has a gear ratio of 99:1

The blue bicycle would be excellent for high velocity racing. But since you lose force at the ratio of 99:1, you'll never get it up a hill. Can you make comments about the red bike as a comparison?

Choose a high gear ratio to multiply your speed. Choose a low gear ratio to accelerate or climb hills.

You can see why bicycles that let you change the gear ratio to suit driving conditions are desireable.

Student Project: Notice that the diameter of the gear, located in the hub of the rear bicycle wheel, has a small diameter compared to the diameter of the tire itself. This forms another type of machine known as a wheel and axle. Find out more about the wheel and axle, more about gear ratios and how they affect the performance of a bicycle.

V. The bicycle fit.
  A. Frame size.

V. Buy a bicycle that fits you.
  A. The frame size is measured as the height of the frame bar that extends from the pedal axle to the seat bar. More than anything else, this determines the fit.
    1. The height of the seat is usually adjustable from 4 to 6 inches for height.
    2. The amount of adjustment in the handle bars is very small. If they're too low when you buy the bike, they'll always be too low.
  B. Tire diameter. In general, the large ther tires, the more efficient use of your energy. But larger tires often mean a frame that won't fit.
  C. You should be able to just stand while straddling the frame.

VI. Accessories

VI. Here are some:
  A. Baskets
    1. handlebar
    2. Rear wheel
  B. Horn or bell
  C. Lights and reflectors: Required by law in most states for night cycling. (High visability vests).
  D. Infant seat
  E. Irritant spray for dogs.

VII. Safety

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VII. A cyclist has very little protection for such high speed travel. Be careful!

  A. Ride with traffic
  B. Wear bright colors
  C. Watch out for car doors that suddenly open.
  D. Motorists don't watch out for bicycles.
  E. Dodge storm sewers which could trap front tire.
  F. Beware of thieves.
    1. Big business
    2. Buy a heavy chain lock.
    3. Take bicycle inside your office when you arrive at work if you can.

AIRCRAFT

AIRCRAFT

I. Introduction.	I. The two main types of pollution caused by aircraft are noise and air pollution. The first affects mainly those living beneath air traffic lanes but the second affects us all.
II. Noise A. The Jet Engine	II. There will never be a noiseless Jet Engine. A. The jet engine developed in the late 1930's to the early 1940's. (1940 - First jet engine, the Bell - 59A, General Electric)
B. Shearing effect	B. Origionally most of the noise was created by the "shearing effect" of high velocity jet exhaust cutting through the ambient air.
C. The Turbofan engine	C. The development of the turbofan engine reduced exhaust noise, but now the engine itself produced high noise levels. 1. These high in pitch 2. Most people judge high pitch noise to be more annoying than low pitch noise. 3. But as engines became more powerful, the exhaust noise went back up again to origional levels.
D. The Daisy	D. 1957 - General Electric developed the "Daisy" sound supressor. 1. Reduced noise 5 db with a thrust loss of only 0.5%. 2. A 3 db loss means cutting the sound power in half. (Refer to loudness).
E. The Aft-fan	E. The Aft-fan configuration was like a doughnut effect. 1. Jet exhaust surrounded by a larger, cooler, slower column of air. 2. Reduces "shearing" effect. 3. Also called Bypass Turbofan
F. The Siren Effect	F. Most students are familiar with the sinple mechanical siren (police, ambulance, etc.) 1. The fan blades of the turbojet engine, turning past the air inlet guide vanes, make a powerful high pitch siren, unfortunately. 2. How to eliminate this siren affect: a. Eliminate the air inlet guide vanes (a 4 db reduction resulted). b. Change the spacing of alternate sets of blades so they produce sound waves 180 degrees out of phase (one wave pushes when the other pulls) and cancel each other. (This resulted in a 6 - 7 db reduction).

G. Aircraft Speed	G. Speed 1. Sonic Booms (already studies): most aircraft do not fly at supersonic speeds at low altitude in countries at peace. 2. Aircraft speed has no affect on loudness. 3. The faster the craft, the less time spent in the vicinity of the listener.
H. Altitude	H. The Inverse Square Law 1. An airplane twice as low will result in 4 times the sound pressure reaching the listener. 2. Should fly at high altitudes. 3. High rate of climb at take off carries risk. 4. At the source: Today's commercial jetliners produce sound equal to a 10,000 watt high fidelity amplifier.
I. Reversing the Jets	I. Reversing the engine thrust allows a jet to decelerate when making a landing approach. 1. Reversing the engines is very noisy 2. High pitch whine
J. The Price to Pay for Sound Reduction.	J. Quiet jet engines cost more 1. For research 2. Additional weight 3. Possible performance loss 4. Additional cost on top of basic engine price.
III. Air Pollution	III. Exhaust Fumes and Smoke
A. Sir Isaac Newton	A. A Jet engine must emit exhaust to fly. 1. Any barrier to stop rearward exhaust would receive a rearward push that would cancil out the forward thrust that propels the aircraft forward. 2. Newton's 3rd Law of Motion.
B. Smoke Trails	B. The public once enjoyed seeing smoke trails in the sky; but not anymore.
C. The more fuel burned, the more air pollution.	C. It takes about 100 tons of fuel to get 100 passengers from New York to Los Angeles.
D. The weather	D. The green house effect 1. High altitude smoke 2. May affect the earth's climate

E. Clean your house	E. People who live below air traffic lanes have to dust more often.
F. Non Visable emissions	F. These may also be irritants to the environment. 1. Carbon monoxide. 2. Unburned hydrocarbons. 3. Oxides of nitrogen and of sulphur.
G. Any Progress?	G. The Axial Swirler 1. Improves mixing of air with fuel prior to ignition to eliminate rich products of fuel that are not completely burned. 2. Incomplete combustion of fuel a major source of pollutants. 3. This also increases efficiency.
H. Fuel Dumping	H. Aircraft fuels are very volatile. 1. Pilots fear a landing with large quantities of unburned fuel aboard. 2. So they jetison the fuel (dump it) as they make their landing approach. 3. This is illegal a. But they do it anyway b. Fuel disperses in the air into little droplets that take hours to rain down on houses, cars, crops, people below. Who would know where it came from? c. Aviation fuel is very corrosive. It eats paint off of houses, cars, alluminum siding. d. Pity the poor people who live in an airport traffic approach. e. Don't buy a house there.

Student Project: One of natures most beautiful wonders, the Everglades of Florida, now has its own airport. Report on this from an ecological point of view. Warning: Don't research this project if you sicken easily.

SOLID WASTE

SOLID WASTE

I. This is not meant to serve as an entire unit on solid waste. It is hoped that the instructor can make use of some of the information contained here.	
II. Are we really trying to solve the problem?	II. In 1965 $150,000 was spent on solid waste study. In 1965 $16 billion was spent on outer space.
III. Where does it come from? A. Garbage	III. We all do our part to make waste. A. Garbage - organic leftover from your table. 12% of solid waste.
B. Refuse	B. Another name of solid waste is refuse. 1. 61 billion pounds of paper is discarded per year in the U.S.A. 45% of all solid waste. 2. Americans use 1.2 billion squeeze tubes per year. (mostly lead). 3. Americans junk 6 million cars per year, enough to fill Cleveland, Ohio. Student Project: About 1,000,000 cars are abandoned on American streets each year posing quite a clean-up problem. If you were a legislator, what would you suggest to prevent this? It should be enforceable. Strict punishment is not always the best way. What do you think? 4. Ashes are 10% of the solid waste 5. 2 billion tons of manure per year. 6. Plastic containers are becoming very popular. a. not biodegradable. b. When burnt, cause chemical air pollutants, corrosive to metals. c. Plastic garbage bags prevent the decay of their contents. Student Project: How are our solid waste problems being affected by the new types of products we use? 7. As society becomes more affluent, we throw away more. 8. The average amount of solid waste per person each day is 5.2 lbs (not counting industrial waste).

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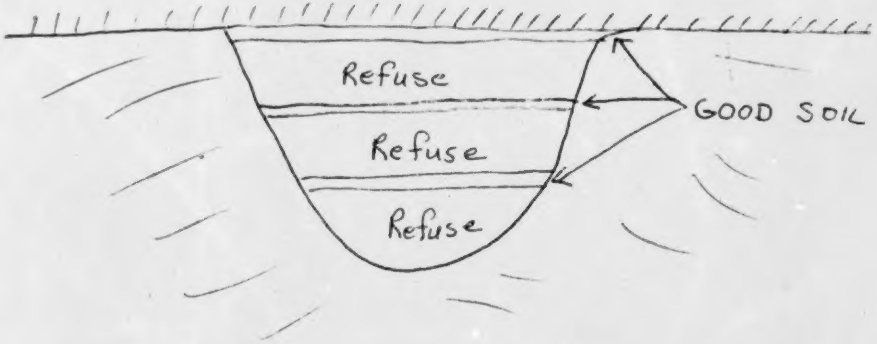
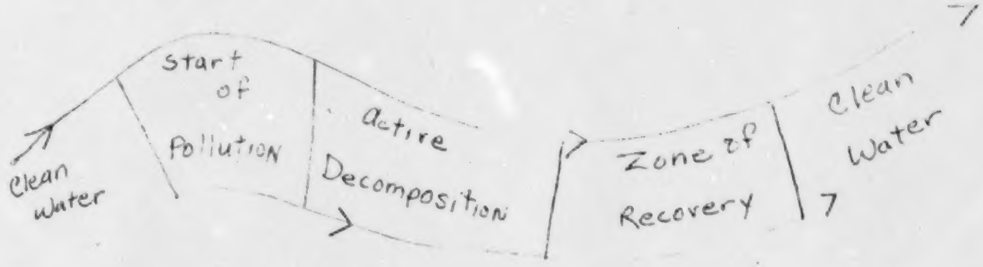
IV. Dilution is not the solution to pollution.	IV. There are a great many people in the U.S.A. It is piling up fast. Here are some disposal methods.
A. Incineration	A. Incineration means complete combustion. 1. Burning is not complete combustion 2. Only 6% of "incinerators" give complete combustion.
B. Grinding	B. Grinding to reduce volume 1. Good method to use for sanitary land fill. 2. Bad if you plan to recycle.
C. Sanitary Land Fill	C. Best method if properly designed. 1. Choose proper location far from water table. 2. Cheapest way to do things right 3. Add 18 inches of good soil every 10 ft of refuse. 4. Prevent infiltration from the top down. 5. Good soil contains bacteria for degradation. 6. On top. 1st year plant wheat or rye. Second year plant legume. Question: Why do you think the litterbug is less of a problem today than he was 5 years ago?



WATER POLLUTION

WATER POLLUTION

I. This is not meant to be an entire section on water pollution, but merely supplementary material.	
II. Drinking water is important	II. People drink 4.5 lb/day, each.
III. Cities always developed along waterways.	III. They would get drinking water upstream and dump sewage downstream. What happened when cities developed near each other?
IV. To purify a stream.	IV.  Clean water Start of Pollution Active Decomposition Zone of Recovery Clean Water Example: A stream with a flow of $100 ft^3/sec.$ and a temperature of 25°C, receiving sewage from a town of 40,000 needs 96 miles and 8 days to cleanse itself. 1. At higher temperatures, water holds less oxygen for bacteria to use. 2. At higher temperatures, more distance and time is required.
V. Bernolli's Principle	V. The narrower the river, the higher the velocity of the water at that point. A. Higher velocity water will carry away more debris. B. Where a stream or river suddenly widens, the water velocity will decrease. 1. This is where much of the debris will settle out. 2. What about a river that temporary widens into a lake? Which end of the lake would be the dirtiest?

POWER

ELECTRIC POWER

I. America's heart runs on electricity. Electricity is energy. But where does this energy come from?	I. Americans are consuming more and more electricity.
A. Where the power goes.	A. Power consumption has doubled every 10 years for the last 30 years. 1. By the year 2000 we will need 8 time the 1970 electric power requirement. 2. In 1970 the supply just barely equaled the demand. 3. Blackouts and Brownouts a. Blackout - loss of electric supply b. Brownout - A voltage reduction of about 5% to concerve power. i. can damage some appliances (motors) ii. consumers requested to unplug refrigerators and freezers to prevent damage to them. 4. We are close to a shortage of coal. Natural gas supply is even worse. It takes fuel to produce electricity. 5. 41% of the U.S.A.'s electricity us used by industry. 6. Homes and commercial users split another 49%. 7. 10% is lost in transmission.
B. How does electricity pollute?	B. The production of energy from fuel causes the pollution. 1. Air pollution from burning of coal or natural gas. 2. Radiation from nuclear fuels. 3. The use of great quantities of water which are returned to lakes and rivers at high temperatures.
C. Why do we use more?	C. Can we condemn the utilities for trying to provide us with power and then turn around and fill our homes with endless electrical gadgets? 90% of the growth in usage due to higher per capata use. Only 10% is due to population growth.
II. Where does our electricity come from?	II. Electromagnetism.
A. The Law of Electromagnetic Induction.	A. In 1831, Michael Faraday and Joseph Henry (of Syracuse, N.Y.) working independently, discovered that an electric voltage is set up in a conducting wire whenever the wire cust across a magnetic field.

B. Conservation of Energy.	B. The Law of the Conservation of energy tells us that to get electric energy out, we must put energy in. It takes force to push the wire through the magnetic field. (Lanz's Law)
C. Energy is not free	C. The more energy you take out, the more force you need to move (push) the wire through the magnetic field to generate the electricity.
D. Increasing the power.	D. The more wire cutting across the field and the stronger the field, the more electricity you'll get out.
E. The generator.	E. By rotating miles of wire shaped into coils in a powerful magnetic field, we will have a generator that can produce tremendous electric power.
F. But where does the input energy come from?	F. Four most common sources of energy in order of popularity: 1. Burning coal 2. Burning natural gas 3. Oil 4. Water Power 5. Nuclear Fission
III. Water Power	III. The sun's energy evaporates billions of gallons of water and lifts it high into the atmosphere.
A. Precipitation	A. Some of the precipation (rain or snow) falls on high elevated grounds (mountain tops, etc).
B. Potential Energy	B. At high elevations, the water has gravity potential energy.
C. Kinetic Energy	C. As the water, pulled by gravity, falls to lower altitudes through streams and rivers, it aquires much kinetic energy as it picks up velocity.
D. Water Wheel	D. If a water wheel is placed in its path, the water rushing past causes the wheel to rotate.
E. The generator	E. This rotating water wheel is connected to the coil (armature) in the generator so it too begins to rotate within the magnetic field and electricity is generated.

F. Transmission

F. The electricity is carried across country by transmission lines (power poles). Some people consider these wires to be a form of "eye" pollution, but perhaps we have more serious things to worry about.

G. Pollution free

G. Water power is nearly pollution free, but the locations of large volume, high energy, high velocity rivers are few. Sorry!

IV. Steam Turbines

IV. The burning of organic fuels heats water and turns it into steam under pressure. The steam is rushed through giant turbine blades causing them to turn (rotate) and they are connected to the armature of the generator.

- A. The burning of fuels pollutes the air.
    - 1. One generator owned by Consolidated Edison, on the Hudson River, burns over 100 railroad cars full of high density coal dust each day.
    - 2. Natural gas is cleaner burning than coal, but its sources are dwindling.
- B. Homes burn fuel in furnaces during winter to keep warm.
    - 1. This is a source of air pollution, but
    - 2. The colder the outdoor temperature, the faster the hot chimney exhaust rises high into the atmosphere.

V. Nuclear Fission Power

A. Nuclear Fission

1. Sample reaction

V. A controlled nuclear reaction provides the energy to create steam under pressure to turn the electric generators.

- A. The breaking up of a large unstable mucleus to yield two or more smaller, more stable meuclei is called nuclear fission.
    - 1. Sometime fission reactions give off energy. Here is an example:

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Br^{138} + {}_{36}Kr^{95} + 3\,{}_{0}n^{1} + \text{Energy} + \gamma$$

u = uranium
n = a neutron, which when absorbed by uranium caused the fission
Br = barium
Kr = krypton
γ = dangerous gamma radiation.

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2. Chain Reaction	2. Notice that the neutron starts the reaction and we get out three more neutrons which may now be absorbed by other uranium neuclei. This makes possible a chain reaction - a fission reaction that keeps itself going (self-sustaining).
3. The Critical Mass	3. The greater the mass of uranium present, the better the chance of each neutron being absorbed before it flies out of the block and is lost in space. If we are slightly past the "break even point", we would have a chain reaction. The minimum mass of nuclear fuel (such as uranium or plutonium) necessary to sustain a chain reaction is called the critical mass.
4. Controlling a Fission Reaction.	4. A Fission reaction out of control would be a nuclear bomb. We can control it by controling the neutrons. a. The nuclear fuel is placed in long, hollow, aluminum pipes (called slugs or stringers) each containing less than the critical mass of fuel. Do you know why? b. Together, the nuclear fuel in several slugs may exceed the critical mass. c. The slugs of fuel are placed in the nuclear reactor (pile). d. Between the slugs are tubes of Boron or cadmium called control rods. These materials absorb neutrons, without which the reaction can not go. e. The control rods can be pulled out to let more neutrons through from one slug of fuel to another and thereby speed up the reaction. f. The control rods may be pushed in to absorb more neutrons and slow down the reaction. g. The reaction produces tremendous heat energy which is used to heat water to steam and drive turbine generators to make electricity. h. What about pollution. i. no unburned hydrocarbons to dirty the air. ii. the leakage of radiation (gamma rays) can probably be be controlled. iii. But the reactor requires constant cooling with large volumes of cool water. The water is usually pumped from a nearby lake or river and later returned. But it may be returned at a temperature 20° hotter than when it was first "borrowed". This can affect marine life.

iv. The more nuclear reactors we have, the greater the quantity of radioactive waste to despose of.

v. The main nuclear fuel is Plutonium. Plutonium produces a radioactive isotope Strontium - 90 when it fissions. This isotope is so similar to calcium that if it is taken into the body, it is deposited in bone tissue and causes bone cancer. Reactors must be carefully shielded to prevent loss of strontium - 90.